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New Zealand Geographer

VOLUME VIII October, 1952 NUMBER 2

# NEW ZEALAND FISHERIES: A GENERAL SURVEY

### DONALD PATTON

IN the last decade there has been sharply increased concern about the earth's actual and potential production of food. The serious insufficiency of food production in many parts of the world and the obvious defects of many food distribution channels have not only created immediate problems, but have also brought into sharp focus the possible implications of the world's continuing population increase. In this global stocktaking, in which the interim committee of the United Nations Food and Agriculture Organization is helping to point the way, the resources of the sea must be assessed as well as those of the land. Whilst agriculture must continue to meet the brunt of the world's food needs, fisheries will be required to contribute more in the future than in the past. Whether New Zealand's fisheries can be made to yield more copiously remains to be seen. But the problems, the opportunities, and the limitations of New Zealand's fisheries deserve to be better known.

A number of the general as well as the particular features affecting fishing off the islands of New Zealand are perhaps viewed more clearly if they are portrayed against the background of world fishery. When one looks at the great fishing grounds of the world, the long-range goal of increasing productivity from the sea appears eclipsed by the urgency of the more immediate problem of conserving fisheries in order to maintain existing levels of production. Disturbing reports of reduced catches, smaller average size of fish, and increased distances to profitable fishing grounds, which have occurred from time to time in the reports of the Marine Department of New Zealand, are similar to conditions which have confronted a number of the world's fishing areas. Since the waters off New Zealand have been fished for a shorter period of time compared with those off northwest Europe and eastern North America, problems of conservation have arisen more recently but are still fundamentally similar to those in the northern hemisphere.

The problem of utilising a fishery resource most effectively on a long-range basis is one which is world-wide in its applicability but regional in its details. Maximum sustained yields of New Zealand's fisheries will depend in part on the discovery of the approximate optimum intensity of fishing to be carried on in each of the offshore areas. But a fishery resource has until now been one of the least knowable resources since it occurs in a medium which man must explore primarily by indirect means; consequently, the rather narrow transition zone between overfishing and underfishing is difficult to ascertain and may change from time to time. Off New Zealand's coasts, certain waters, such as the Hauraki Gulf, have clearly been overfished; other areas, particularly off the South Island, could well produce more on a sustained yield basis than at present, if larger markets were established for the produce at today's high prices. Gradually, New Zealand's major fishing grounds are becoming better known, along with the numbers, habits and characteristics of their fish population. As yet, these grounds are much less known than those of the major northern hemisphere fisheries, but, meanwhile, the nations bordering these better-known fishing grounds are initiating a new phase of development—in their deep-sea pelagic fisheries.

The sea still remains one of the great frontiers of human knowledge. Barely a century has elapsed since the initial large-scale hydrological and marine biological researches were instigated. Marine research, both hydrological and biological, has logically and understandably been concentrated on and in the shallow rims of the seas flanking the continents. Some marine bottoms in the North Sea are better known than many areas of terrestrial surface in some of the less accessible parts of the world. But for the nations directly concerned with these well-known offshore fisheries, larger increments to the total catch may not necessarily come from a further study of the offshore areas and their life as from a better understanding of pelagic species over the much larger areas of the ocean deeps. The Japanese, with intensively-worked and somewhat depleted inshore fisheries, have increased their operations for a distance of 2000 miles and more over the open Pacific eastwards from the Japanese mainland, the Bonins, and the Marianas. The United States Congress has recently voted a million-dollar research fund for investigation of tuna in the North Pacific—an appropriation unprecedented in congressional history. Intermediate depths of the deep ocean basins may likewise be made to account for some production of fish in the future. Although the shallow epicontinental seas will in all likelihood remain the primary fishing grounds of the seas, the deeper and areally much greater parts of the world's oceans will inevitably increase their absolute production of sea food in the future, as they are doing already. In the near future it is possible that a continued expansion of fish landings at New Zealand ports may necessarily be based on a far-reaching extension of fishing operations over the deeper parts of the Pacific and the Tasman beyond coastal waters.

## New Zealand's Share of World Fisheries

The meat, milk, butter and cheese production of New Zealand's pastoral agriculture comprises a very necessary part of the world's food supply. But in spite of its insularity and the distribution of most of its people on or close to the coast, New Zealand's marine biological resources are of slight importance compared with the products of the soil—far different from the case of Iceland where the surrounding seas are overwhelmingly more productive than the land. Whereas New Zealand's pastoral output is chiefly exported and is the main basis of the national economy, the fisheries of New Zealand are almost entirely for home supply. Only one eighth of the fish harvest is normally exported.

The northern hemisphere has almost a world monopoly of the world's commercial fisheries. The world has averaged a 39,000 million lbs. intake of fish during recent years, 98 percent of which was caught in the northern hemisphere.[1] Landings of fish at New Zealand ports, which were 55 million pounds in 1948,[2] are about seven percent of those of the southern hemisphere, where Brazil, the Peruvian and Chilean west coasts of South America, southeastern Australia, and the Union of South Africa account for most of the total. On the basis of oceans, the Pacific, with 48 percent of the world total, does about as well as the Atlantic, with its 47 percent of the world total, since each of these oceans has two great fishing grounds—along the eastern and western margins of the North Pacific and the North Atlantic, respectively.[3] The remaining five percent of the world's fish harvest is contributed by the Indian Ocean. If the Pacific alone is considered, fisheries north of the equator, of which those off the coasts of Japan are much the most important, account for almost 98 percent of the ocean's total. The southern hemisphere seas are still of minor importance in the fishing industry, and because of conditions on both land and sea, they can expect to increase their relative importance only slowly.

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[1] *Report of the Technical Committee on Fisheries.* Submitted to the U.N. Interim Commission on Food and Agriculture, April 13, 1945, Washington, 1945, pp. 2 and 7.

[2] N.Z. Marine Department: 'Report on Fisheries for the Year Ended 31st March, 1949', in *Append. Journ. House of Repres.*, (H-15), Wellington, 1949, p. 2. This figure includes all fisheries products except rock and dredged oysters and mussels, which are tabulated on a volume, rather than a weight, basis.

## Fishing in the Pacific

The four quadrants of the somewhat circular Pacific Ocean are strikingly different in their intensity of fishery exploitation and in the general methods of fishing employed, and their brief comparison helps to throw in relief the fisheries of New Zealand. In the northwest Pacific, the fisheries off Japan and secondarily off China are pursued extremely intensively with all types of equipment from the smallest and most primitive to the most modern, but in general neither vessels nor gear are powered. In the northeast quadrant of the Pacific, along the coasts of North America from the peninsula of Lower California to Alaska, fishing is highly important but less intensive than in Japanese waters, and is carried on by the most highly mechanised fleet of fishing vessels operating in any of the world's fishing grounds. Off the coasts of the southeast Pacific, from Tierra del Fuego to the southern Ecuadorean coast where the cold Peru current curls west into the Pacific, marine life is profuse, but commercial fishing is underdeveloped and only now receiving serious attention. In the southwest Pacific, off New Zealand and Australia, the fishery resource is probably smaller than in any other quadrant of the ocean; fishing is pursued on a small scale, but nevertheless vigorously relative to the resource of the fishing grounds. Equipment and vessels are diverse and mechanised to a considerable extent, more so relative to the amount of fishing carried on off the coasts of eastern Asia. New Zealand, thus, neither fishes its surrounding waters as thoroughly as does Japan, nor has it ignored its offshore waters as have Peru and Chile. Its attention to its fishery has been more or less in keeping with the fishery endowment of its surrounding waters. Intensity of fishing, a critical point for any fishing ground, places New Zealand in a somewhat intermediate position as far as the Pacific world is concerned. But the modest intensity of fishing in New Zealand waters is an outcome of terrestrial attributes as well as marine conditions.

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[3] The Arctic fisheries around Iceland and to the north of Europe are considered to form part of the Atlantic total.

If there is little variation in the kinds of fish in the seas of the world, there is, on the other hand, enormous variation in the commercial production. Probably over 90 percent of the fish taken are caught in the shallow seas surrounding the margins of the continents, where the depth of water is usually less than 75 fathoms or 450 feet, and frequently less than 50 fathoms or 300 feet. In these shallow seas, the rims of the continents are awash, or flooded as it were by oceans which have too much water to be contained in the great abysses which lie out beyond the continental margins or shelves. The continental shelves may vary in width from a few miles to scores or even several hundred; occasionally they are absent entirely. Beyond their outer margins, where the water may be anywhere from 50 to 300 fathoms deep, the steeper descent into the great ocean basins begins, and the shallow seas with their prolific fisheries end. It is beyond the edge of the continental shelves where the average seaward slope steepens from 0.07 degrees to 4.7 degrees that a frontier in the world's fisheries now exists, and is being penetrated only slowly.[4] Up until the present, man has found the continental shelves to offer far more than anything to be expected beyond them. Virtual limitation of fishing to the continental margins has in general been true of New Zealand as of the world as a whole.

The shallow seas provide optimum conditions for fish life. Microscopic plant life, upon which all life in the sea ultimately depends, is able to thrive in all parts of the surface layers of the oceans, down to an average depth of 50 fathoms or 300 feet, the maximum depth to which light can penetrate. But the smallest of plants need more than light to manufacture their food, and their other requirements are ordinarily best met on continental and insular shelves. In the shallow waters fringing continent and island, where presumably life itself began, waves, currents, tidal undulations and temperature contrasts cause a mixing of the water layers, thereby stirring up mineral salts from the sea bottom and distributing them throughout the water layers. Additions of mineral supplies, in suspension and solution, are poured into coastal waters by rivers from the adjacent lands. Minute free-floating vegetable life, or phytoplankton, nourished by these mineral salts, by water, and by carbon dioxide in the water, may exist in large numbers and form a feast for comparable hordes of minute animals, or zooplankton. The plankton content of the seas, vegetable and animal, becomes the ultimate mainstay of the larger forms, including the comparatively few species comprising the commercial fish of the world. In the shallow, continent-bordering seas, too, man has always been closest to home and to the shelter of harbours. Safety, convenience and economy all favour the coastal fisheries.

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[4] F. P. Shepard: *Submarine Geology*, New York, 1948, pp. 144 and 187.

## THE DOMINION'S FISHING GROUNDS

Nature has endowed New Zealand with a rather niggardly share of insular shelves. The average width of continental shelves has been computed for the world as a whole at about forty-two miles,[5] whereas New Zealand's insular shelves have an average width of only about twenty-five miles.[6] The world average, moreover, is one which is reduced by many hundreds of miles of narrow shelf, as along the coast of southwest Africa; the major fishing areas in the northern hemisphere all enjoy continental shelves averaging over forty-two miles in width. New Zealand's insular shelves, too, lack numerous 'banks', flat to gently-sloping areas, surrounded by deeper water, but overlain by shallow sheets of water. The long slopes down to the Pacific and Tasman abysses are usually near the shoreline.

Dissemination of mineral salts throughout water masses over continental and insular shelves is implemented by stormy conditions or strong tidal currents. Tidal movements are rather weak in the waters around the dominion, but storminess, particularly from Cook Strait southwards, is frequent and severe enough to cause a considerable amount of general mixing of waters, thus increasing the mineral content and ultimately implementing the food supply of fish. Although stormy days confine fishing vessels to port, the succession of storms which encircle the globe between forty and fifty degrees south are probably of long-range benefit to the fishery resources in New Zealand waters.

New Zealand is also far enough south for winter chilling to reduce surface water temperatures substantially, thus tending to remove a 'thermoclinal' barrier between warm, less dense surface water and cold denser subsurface water, allowing a renewal from below in the supply of mineral salts in surface waters every winter.

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[5] Shepard: *op. cit.*, p. 143.

[6] This is a tentative estimate by the author based on a study of hydrographic charts of New Zealand waters. Soundings of New Zealand offshore waters are not numerous enough as yet to permit an accurate estimate. The extensive but rather shallow expanse of the South Taranaki Bight may make the average figure a little higher than that given above.

New Zealand's fishing grounds, however, have no strong and persistent upwelling of deep water, with attendant constant renewal of mineral salts, such as is found off the west coast of South America. There, prevailing offshore winds and the deflective force of the earth's rotation causes persistent upwelling of deep water to take the place of water which has been displaced, and marine life abounds.

Several of the world's largest fishing grounds are along lines of discontinuity between warm and cold water. Mixing and stirring of the water is encouraged, mineral salts and planktonic life are profuse, and fish move over rich harvest grounds. This factor in world fisheries is likewise nonexistent around New Zealand, where sharp impingement of two different masses of water does not occur. The marine biologic resource may well be the poorer off the coasts of the dominion for lack of this type of source area for fish food.

Fish may be as abundant per unit volume of surface water in the tropics as in middle latitudes or in subpolar zones, but fish life in colder seas seems to be concentrated in a small number of forms or species. Probably no tropical species are as great in sheer numbers as the herring, haddock, or cod of the northern middle latitudes. Extreme heterogeneity of fish life in the warm waters engirdling the earth is replaced poleward by a lesser heterogeneity, in which fewer species of fish may occur in modest to large numbers, either in schools or individually. The problems of catching and processing are always easier in commercial fisheries when a single type of fish, or at most a few types of fish, have to be dealt with. The approach towards a greater homogeneity per unit volume in colder waters poleward of the tropics, and particularly in subpolar waters, may well be due in part to a planktonic food such as diatoms which seasonally appear here in fantastic quantities, giving the water an opaque greenish cast and a greasy feel compared with the azure colour and clarity of tropical water. Commercial species of fish depending directly or indirectly on a diatomic feast correspondingly find their range restricted largely to cooler waters. Such fish may be relatively few in species, but large in numbers.

The currents in New Zealand's bordering seas are prevailingly from the south, and the offshore surface water temperatures are 60°F. or less, except north of forty-two degrees south in summer, where surface water temperatures from 60°F. to 68°F. occur.[7] The slow northeastward-moving drift off the coasts of Otago, Canterbury and Marlborough continues past Cook Strait towards Hawke Bay and East Cape, becoming somewhat warmer as it proceeds. This east coast drift has its origin primarily in the cold, stormy waters of the southern ocean to the west and southwest of Stewart Island. The west coasts are no warmer. An easterly drift across the Tasman Sea impinges on the west coast of the South Island in the vicinity of forty-four degrees south and divides, one current turning south past the mouths of the fiords to Foveaux Strait, the other current moving north towards North Cape.[8] Once past North Cape, this current appears to turn southeast towards East Cape. In general, the North Cape to East Cape area has the warmest offshore water. Surface drifts of warm water from the direction of the Fiji and Tonga groups towards the northern coast of the North Island in late summer, particularly, may further increase the temperature of offshore waters between North and East Capes.

New Zealand, then, is surrounded primarily by cold seas, conditioned in large part by the northward set of the currents off its coasts, but the general north-south orientation of the country, between forty-seven and forty-three degrees south, results in considerable temperature differences between Stewart Island and the Three Kings. These prevailingly cold waters have abetted a commercial fishery based on a few standardised species, a characteristic of middle latitude and subpolar fisheries the world over, although the northernmost parts of New Zealand's fishing grounds show some affinities with subtropical fishery conditions.

## ENVIRONMENTAL FACTORS OF THE LAND

Adequate fishing grounds are far from the only requisite for a commercial fishery. The distribution and importance of the world's fisheries are as much an outcome of conditions on land as of conditions in the seas. Abundant fish offshore does not automatically call into being an active group of fishermen. The physical characteristics of the land, its capacity to support agriculture, its density of population, and even cultural characteristics of its people are all part of the total fishery situation.

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[7] Data from Sea Surface Temperature Charts, Western Pacific Ocean, U.S. Hydrographic Office, Washington, D.C., 1943.

[8] E. Kidson: 'The Elements of New Zealand's Climate', in B. J. Garnier (Ed.): *New Zealand Weather and Climate,* Special Publication of the New Zealand Geographical Society, Miscellaneous Series No. 1, 1950, p. 46.

The dominion has far less need of the biotic resources of the sea than many of the world's important fishing nations.[9] New Zealand is situated far enough equatorward to support a vigorous agriculture, unlike subarctic Iceland. Although mountainous, its mountains do not preempt most of the land area, leaving agriculture to cling precariously to fringe areas as in most parts of Norway. The soils of its agricultural lands are deeper and more responsive than the intractable podsols of Newfoundland. Its population density is low, only 17.9 per square mile, compared with England's dense population of over 750 per square mile, or the teeming millions living on Japan's sea-girt lowlands, and its population does not have religious reasons for a large consumption of fish.

It is perhaps fortunate that New Zealand has not had to depend more heavily on the surrounding seas than has been the case up to the present. The seas have augmented, rather than sustained, the national food supply. In view of the modest amount of fish life in the seas around the country, the fishery resource may already have been overexploited in scattered areas, but overfishing on a large scale has not ensued, and an opportunity for a long-range, wise use of the fishery resource remains available. Since the dominion is becoming acutely aware of the need for conservation, this opportunity may well be taken.

The fishery situation in the waters of Argentina offers an interesting comparison with that of New Zealand. Off the coast of Argentina, in latitudes comparable with those of New Zealand, an inherently richer fishery resource is ignored almost entirely. The abundant fish over the broad continental shelf east of Argentina are by-passed in favour of juicy joints of beef, to say nothing of abundant other agricultural products offered by the highly-productive humid pampas of that country. Iceland and Argentina are at opposite poles in the matter of fisheries and their importance in the national economy; New Zealand, although having necessarily a unique fishery situation, is much more comparable with Argentina than with Iceland.

## Locational Factors in New Zealand Waters

Marine harvests are as markedly spotty in their areal distribution as harvests on land. Heavily-fished areas off some coasts of the dominion contrast with lonely seas where fishing vessels rarely appear. Among the whole complex of physical and cultural factors which underlie the distribution of the commercial fishing grounds, and the intensity with which they are fished, distribution of population appears most frequently and most decisively.

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[9] Its fisheries yield slightly less than 30 lbs. of seafood products annually per capita, compared with 48 lbs. for the United Kingdom, 111 lbs. for Japan, 680 lbs. for Norway, and 6223 lbs. for Iceland. (Based on statistics in the annual 'Report on Fisheries' of the N.Z. Marine Department and in the *Report of the Technical Committee on Fisheries, op. cit.*)

Commercial fishing is concentrated on the Pacific side of New Zealand, leaving a very minor catch for the Tasman grounds. East coast ports land about 75 percent of the total catch, while most of the rest is landed at Cook and Foveaux Straits ports which are not definitively either east coast or west coast ports, and at the Chatham Islands. The west coast ports of both islands together contribute only about four percent of the national catch. Only rarely are fish caught on the Tasman side and landed on the Pacific side; thus the port landings are a fair reflection of the catches on grounds off the east and west coasts.

Most of the dominion's population is found on eastern or Pacific coasts. In the South Island the population contrast between the east and west coasts is striking. If the population in the North Island appears superficially to be more easily accessible from the west coast than the east, Auckland throws the balance towards the east coast, as the amount of shipping entering the Manukau is far surpassed by that using the Waitemata. Not only can the bulk of New Zealand's population be reached most directly from east coast ports, but the range of many vessels in the fishing industry, with an average sailing radius of less than sixty miles, also helps to confine fishing operations to the nearer grounds off east coast ports. Few vessels pass in transit through Foveaux Strait, Cook Strait, or the stretch of water between North Cape and the Three Kings.

The latitudinal location of New Zealand places it almost squarely in the domain of prevailing westerly weather. Northland may experience a weakening of westerly weather in summer, but the overall grip of the westerlies never weakens. Not only are storms most severe and most frequent from some westerly quarter, but even under average conditions, the water is somewhat rougher on the western sides of the islands. Boisterous 'seas' can turn the surface of the Tasman quickly into a domain of white-crested waves and blinding spray; uneasy swells may persist for a considerable time after the fury of the storm wind has abated, or may give advance warning of a new storm. Rough weather has more serious implications off New Zealand's western coasts than merely confining ships to port, with an irretrievable loss in fishing time. The western coasts north of Fiordland are almost devoid of good harbours, and fishermen must either choose between straying far from port, with the risk entailed, or remaining within a short sailing distance of a harbour entrance, thus restricting their fishing operations, with an inevitable curtailment of the amount of fish caught. Fiordland harbours are useless for shelter, as the waters off the mouths of the fiords are too far from consuming centres to support a fishery. Still other hindrances beset the west coast fisherman. Most of the suitable west coast ports have harbour-mouth bars, easy to circumnavigate by experienced hands during ordinary weather, and particularly during the occasional periods of beautifully calm weather which may spread over parts of these coasts, but treacherous during running seas. They are formidable obstacles to fishing vessels running to safety before a storm.

Some evidence exists that west coast waters contain fewer fish than east coast waters. This is particularly true with respect to the waters east and west of the Auckland Province. Fishery experience suggests that catches off the west coast of Northland rarely repay the long run out from the Waitemata Harbour past North Cape to the grounds, and larger yields of fish might well have stimulated a larger fishing fleet based on the Manukau. Farther south on the west coast of the North Island, a number of fishermen have complained of rather meagre catches in the South Taranaki Bight. Grounds off the west coast of the South Island ordinarily do not attract fishermen from Wellington. Whether the overall numbers of fish off the west coasts are well below the number off the east coasts is debatable at present, but the existence of a belief on the part of some fishermen that west coast fishing does not pay is in itself a force increasing the relative concentration of fishing off the east coasts.

## The Main Fishing Area

About 42 percent of the total New Zealand annual catch of fish is landed at ports between North Cape and East Cape. Within the North Cape to East Cape area, Auckland itself receives 70 percent of the area's landings and 31 percent by weight of all fish landed in the country.[10] Fishermen from Auckland dominate in this area, although Thames, Tauranga and other ports also compete to a lesser extent. Conditions have been most propitious for intensive fishing over an extensive area in the North Cape to East Cape portion of the coastal waters of the North Island. Harbours, both for fishing bases and as storm refuges, are more closely spaced than in any other section of the country. Offshore waters have somewhat calmer average conditions than in any other fishing ground, as the northward projecting mass of Northland, the Coromandel Peninsula, and the East Cape area all act to break the force of waves. The North Auckland Peninsula is particularly important in cutting off the full force of westerly storms. The latitude of the Bay of Plenty-Hauraki Gulf-Northland area (thirty-five to thirty-eight degrees south) is moreover far enough north to escape some of the stormier weather which dissipates its ferocity before reaching the centre of the North Island.

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[10] Computed from statistics contained in 'Report on Fisheries', *op. cit.*, pp. 4 and 30.

The average width of the continental shelf widens northwestwards from the Bay of Plenty, and from the Hauraki Gulf northwards the insular shelf is above the average for the country as a whole and is within a few hours' steaming from the largest node of population in the country. Auckland depended so heavily on the shallow Hauraki Gulf during earlier years that the inner parts are now closed to commercial fishing.[11]

### Decreasing Importance of Fisheries from North to South

The general distribution of population in the dominion is reflected in the general decreasing importance of fisheries from north to south, although upon this overall characteristic are superimposed local variations—areas of more intense fishing, where especially favourable fishing grounds occur, or where cities provide a local market. Only a few nationally-approved delicacies, such as the Bluff oyster, move really long distances; the insular and elongated nature of the country favour local hinterlands for each fishing port. South Island fishing companies have difficulty in attempting to market excess catches in the North Island and must restrict their catch to their average market. So far the catch available in offshore waters has been ample enough to supply all normal demand in adjacent centres of population, without the necessity for interisland movements, or even for shipments from one end to the other of either North Island or South Island. Intraisland shipments up to 250 miles or even 300 miles may exist, however, in response to locally deficient landings.

Stormier waters southward also help to restrict the volume of fishing;

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[11] Fishing in the Hauraki Gulf has also been restricted in order to protect spawning grounds.

the number of idle days in port increases south of the broad part of the North Island and reaches its height in the Foveaux Strait area. The range of fish available in South Island fish shops dwindles rapidly as storms of several days' duration prevent replenishment of the wholesale market, down to the point where little may be left in the shops except smoked fish and perhaps a few lonesome groper. Thus the mean storminess of the sea, which increases as one approaches Stewart Island, is conducive to the nutrition of marine life at the same time that it helps to conserve that life. This, along with the lesser demand in the south, combines to make the conservation situation better in southern waters than in certain northern waters.

East coast waters account for most of the fish landed in the dominion, yet most of the narrowest sections of the insular shelf flanking the dominion are along these coasts. Two east coast sections with particularly narrow shelves are both lightly fished: one from Cape Kidnappers at the southern end of Hawke Bay southwards almost to Cape Palliser, the other off the coast at Kaikoura and southern Marlborough generally. In both cases, narrow insular shelves at sea are combined with low population density on land. These two areas form the major gaps in the band of fishing activity which extends along the eastern side of New Zealand.

## Conclusion

The overall output of New Zealand's fisheries is modest compared with the great fisheries of the northern hemisphere; the demand is also modest, far less than for the meat products coming from the country's pastoral farms. The demand is roughly proportional to the supply coming from the shallower parts of the dominion's insular shelves, and export takes only about twelve percent of the total catch. Major increments in demand might well lead to overfishing of the shallow-water fishery, and presumably must be met, when necessary, partly by increased fishing for ground fish or middle-water fish over deeper parts of the insular shelves, and by extension of surface fishing far beyond the present range off the coasts.

The current demand for fish is met by fishing particularly the east coasts of the two islands, with a concentration between East and North Capes. The distribution of fisheries as a whole in New Zealand is associated with the width of the insular shelf, exposure to storms, nature of harbour entrances, abundance of marketable species of fish, and the distribution of population.

# THE MAORI POPULATION OF NORTHERN NEW ZEALAND

## JOAN METGE

DESPITE the one hundred and fifty years that have elapsed since they first came into contact with European civilisation, the Maori people of New Zealand have by no means been assimilated by the numerically dominant pakeha population. Not only have they preserved their physical identity but they have evolved a cultural pattern which combines elements of true Maori culture—some retained in more or less modified form, others revived in fairly recent times—with forms resulting from the adoption, with varying degrees of success, of European social and economic practices and institutions. In view of their physical and cultural distinctiveness, of their not inconsiderable numbers, and of the extreme irregularity of their distribution, a more detailed study of the numbers and distribution of the Maori people than has yet been attempted is justified as a contribution to the regional geography of New Zealand. The present study, however, is confined to northern New Zealand where almost three-quarters of the Maori people are found.

Before more detailed social or anthropological work can be carried out, it is essential to examine the distribution of the Maori population and to trace any change, or tendency to change, which is affecting that distribution at the present time. This essay is a report on the study of the distribution of the Maori[1] in northern New Zealand—an area which may be identified with that known popularly as the Auckland Province and one represented statistically and administratively by the thirty-six northern counties.[2]

In order to provide a better basis for assessing the extent and significance of current changes in the distribution of the Maori population of the Auckland Province, it is necessary to advance from a study of distribution at some period in the past. Two prewar dates have been chosen for this purpose: 1926, as the last census year before the Native

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[1] A distinction may be made between 'Maori' and 'Maoris' as plural forms. The former refers to the Maori people as a whole and as an ethnic and cultural entity; the latter designates individuals of this people (cf. *The Coming of the Maori* and *Some Modern Maoris*).

[2] In 1951 72.26 percent of the Maori population of New Zealand was living in these thirty-six counties.

Land Act of 1929, which marked the culmination of the period of physical and cultural revival (although of economic stagnation) following the apathy and pessimism of the late nineteenth century; and 1936, as a convenient halfway point between the inauguration of state-assisted land development and the second world war.

## 1926: Aftermath of the Nineteenth Century

In the mid-twenties the Maoris of the Auckland Province were by tradition and location a rural people. They were, however, far from being uniformly distributed. Not only did nine out of ten Maoris live in the country but almost half the Maori population of the province was concentrated in remote areas where pakeha residents were so few that they were equalled or exceeded in numbers by the Maoris themselves. Maoris who were living in the boroughs and town districts of the province numbered barely 4000. Many of these 'urban' dwellers were living on the remnants of tribal lands which had been surrounded as urban agglomerations had expanded—as, for instance, in the Okahu Bay settlement in Auckland. The number of Maoris in each urban centre was small. With the exception of Auckland,[3] Gisborne and Rotorua,[4] no town had a Maori population of more than 160 and only fourteen had more than fifty. In rural areas Maori settlement was relatively close and continuous about the shores of the Hokianga Harbour and in the Kaikohe district, in a narrow belt along the coast of the Bay of Plenty from Matata to Cape Runaway and beyond East Cape in the valley of the Waiapu River. Rather smaller concentrations, both in numbers and in areal extent were to be found around Te Araroa, in the vicinity of Ruatoki, at the southern end of the Tauranga Harbour, around the Rotorua lakes, and in the north around Whangape and Whangaroa Harbours. Elsewhere they were either scattered in small nucleated communities or were dispersed in isolated family groups over a wide area (*Fig.* 1).

The majority of the Maori population, then, was living in areas remote from pakeha urban centres. In the main areas of pakeha settlement there were exceptionally few Maoris either in relation to the size of the pakeha population or in relation to the area of productive farmland involved (*Fig.* 3). In the area adjacent to Auckland, from

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[3] Auckland here and later refers to the Auckland metropolitan area, that is, Eden County and all boroughs and town districts between and inclusive of Henderson, Takapuna and Otahuhu. In 1926 there were 1101 Maoris resident in Auckland.

[4] In 1926 there were 602 Maoris in Rotorua Borough and 282 in Gisborne Borough.

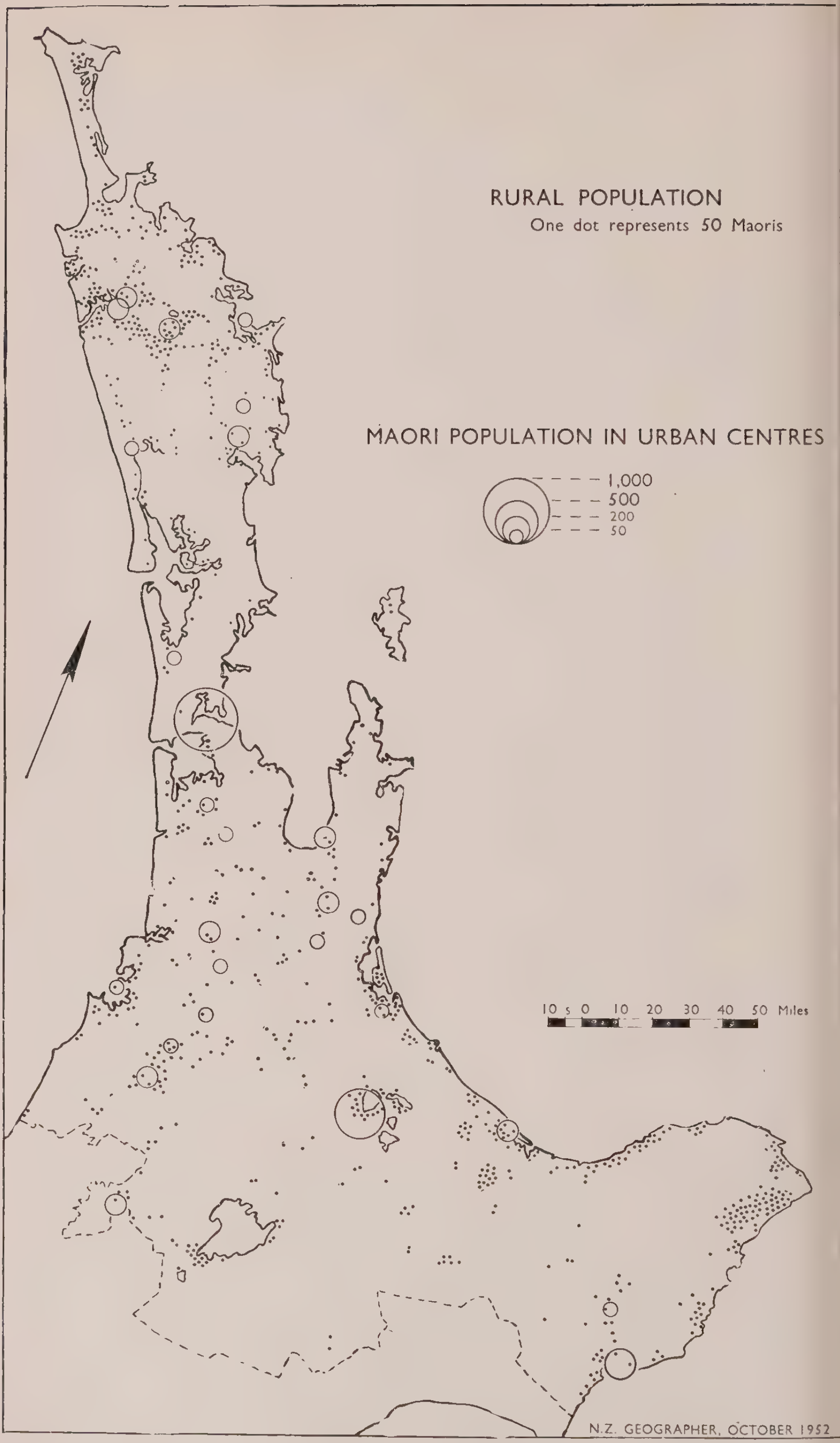
RURAL POPULATION
One dot represents 50 Maoris
MAORI POPULATION IN URBAN CENTRES
1,000
500
200
50
10 5 0 10 20 30 40 50 Miles
N.Z. GEOGRAPHER, OCTOBER 1952

*Fig.* 1. The distribution of the Maori population in the Auckland Province, 1926.

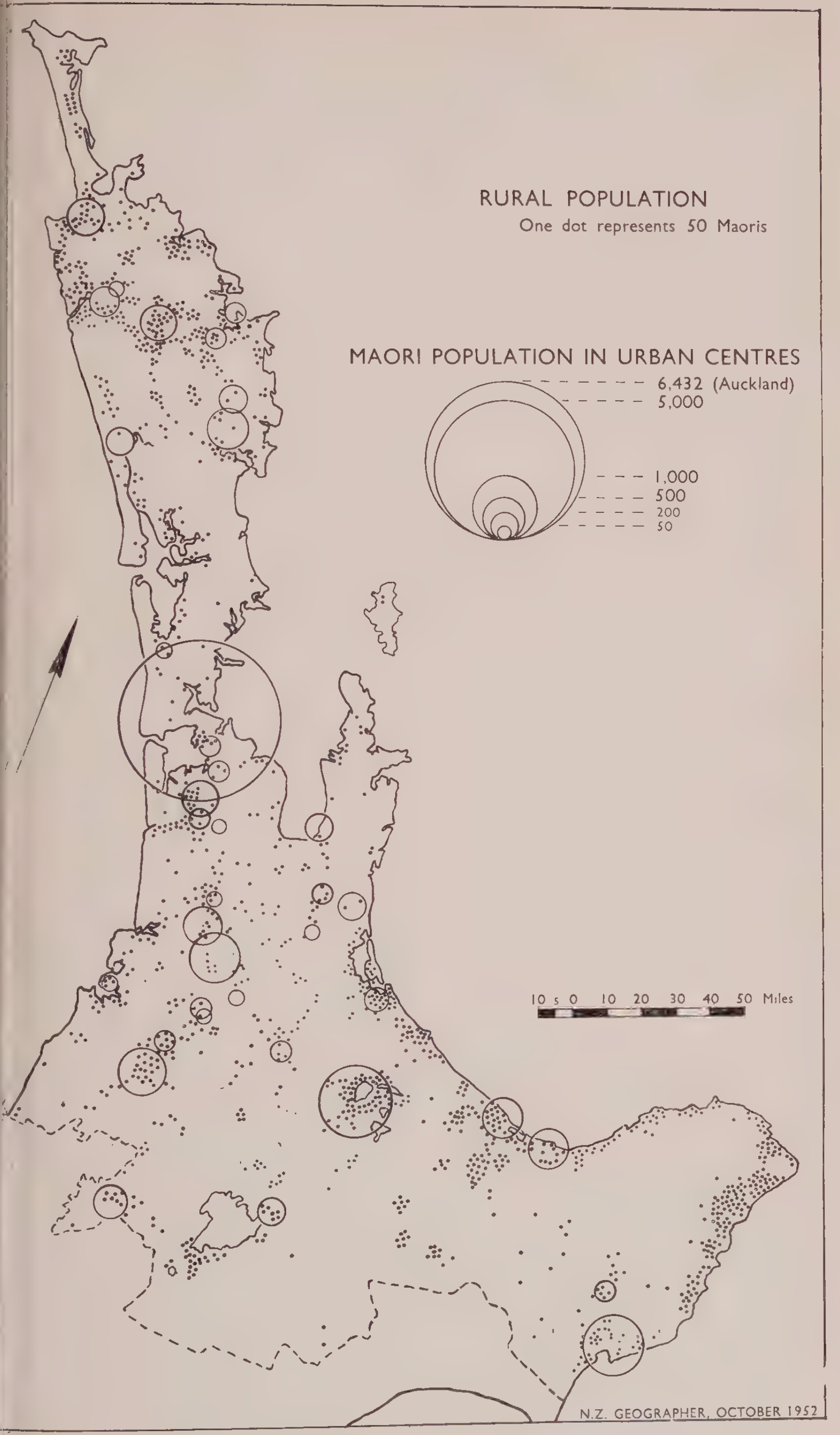
RURAL POPULATION
One dot represents 50 Maoris
MAORI POPULATION IN URBAN CENTRES
6,432 (Auckland)
5,000
1,000
500
200
50
10 5 0 10 20 30 40 50 Miles
N.Z. GEOGRAPHER, OCTOBER 1952

*Fig.* 2. The distribution of the Maori population in the Auckland Province, 1951.

Wellsford in the north to Mercer in the south, and in the Waikato,[5] the foremost farming district of the province, there were fewer than ten, and in many parts as few as three, Maoris to one hundred pakehas. On the other hand, in the far north[6] and in the southeastern and south-central parts of the province the ratio was over sixty to one hundred. In fact the Maoris actually outnumbered the pakehas in, firstly, those parts where they were most densely settled—around the harbours of Hokianga, Whangaroa and Kawhia, on the narrow coastal fringe between Waiawa (to the east of Opotiki) and Cape Runaway, and on the East Coast[7] north of Tokomaru Bay, in the latter case by almost two to one; and, secondly, in certain isolated areas where pakehas were exceptionally few in number, as in the mountain fastnesses of the Urewera and on the Volcanic Plateau outside the Rotorua area.

Locally the pattern of distribution was tending to become more dispersed than had traditionally been characteristic of the Maori. As Peter Buck recorded in 1924: 'Maori communal life is disintegrating. . . . No longer is a group of small huts clustered round a meeting-house typical of a Maori village. Individualisation of land and European needs are dispersing the families to their separate holdings. In many places, the tribal meeting-house stands alone or flanked by a solitary cook-house, patiently awaiting until a death or some object of great moment shall for a brief period draw its people together under its sheltering roof'.[8]

Nucleated settlement had disappeared completely in Northland, on the northern East Coast and in many parts of the eastern Bay of Plenty[9]— in those areas, that is, where Maori families were attempting to farm their own individualised land. In these areas the meeting house (usually accompanied by a church) remained in a very real sense the heart of the Maori settlement, invariably standing aloof from the commercial centre of the pakeha community.

Nucleated settlement persisted in certain parts of the province, however, most particularly in the Waikato and in the vicinity of Tauranga.

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[5] The lowlands of the middle Waikato and lower Waipa Rivers are here taken to comprise 'the Waikato'.

[6] The term 'far north' is used in this article to designate the territory included in the counties of Mangonui, Whangaroa, Hokianga and Bay of Islands.

[7] The East Coast extends from Cape Runaway to just south of Gisborne and from the sea to the crest of the Raukumara Range. It embraces five counties—Matakaoa, Waiapu, Uawa, Waikohu and Cook.

[8] Te Rangi Hiroa (P. H. Buck): 'The Passing of the Maori', *Trans. & Proc. N.Z. Inst.*, Vol. 55, 1924, p. 367.

[9] The eastern Bay of Plenty is that area of the lowland bordering the Bay of Plenty which lies east of Matata.

Here its persistence was a visible result of the pronounced negative attitude of the Maoris towards the Europeans who had taken their land, and it was symbolic of their withdrawal from all but essential economic contact with their pakeha neighbours. Similar nucleated settlements, commonly if erroneously known to the pakeha as *pa,* occurred in the vicinity of Whakatane, Opotiki, Rotorua and Gisborne. These were inhabited mainly by Maoris who lacked title to land sufficient in quantity or quality to support them and their families. Few of these settlements were located on traditional sites on riverbank or lakeshore except where those sites were adjacent to pakeha settlements. Even in the Waikato they were located near to railway, highway or pakeha rural township, for the Maori people as a whole were dependent for money income upon wages earned in labouring casually for pakeha farmers, local bodies and the Department of Public Works, and in seasonal occupations such as shearing, timber-working and gum-digging, which involved long absences from home and much travelling. In the most inaccessible parts of this province—on the Volcanic Plateau, in the Urewera, in the Rangitoto Range and on the Coromandel Peninsula—there still survived a few small self-sufficient Maori communities living at a subsistence level; such were, however, no longer typical.

## 1936: Depression and Land Development

Towards the end of the nineteen-twenties there occurred two events of profound significance to the Maori: the whole world was plunged into a severe economic depression and in New Zealand the government passed the Native Land Act. With the passing of this act provision was made for the first time for the use of official funds in the development of land owned or occupied by Maoris. The repercussion of the economic situation on the Maori people was exceptionally severe because all but a small percentage of Maori wage earners were employed on a temporary basis in those rural occupations which were most susceptible to financial reverses—in timber mills and logging camps, on farms and in shearing sheds, on the roads and in public works camps. Yet in spite of frequent unemployment the rapid rate of natural increase of the Maori population was not checked. The Maori were saved from extreme hardship by their universal practice of cultivating subsistence crops, supplemented in some cases by the systematic exploitation of natural food supplies, and by the unemployment relief provided by the government. In this way they were able to maintain the prevailing low standard of living, but not to better it. More important in the long run was the development of Maori land carried out by the state on behalf of the owners. The Maoris who were receiving unemployment relief were directed to developmental work on their own lands; consequently, work progressed more rapidly through the depression years than might otherwise have been the case. By 1936 some 10,000 Maoris in the Auckland Province were settled on farms which had been brought into production by this means.

Despite the fact that hired labour in primary industries, hitherto the main source of income to Maori wage earners, had been cut to a minimum, a larger percentage of the Maori population of the Auckland Province was living in rural areas in 1936 than ten years previously. No rural area of any size had a decreasing Maori population, but twenty towns had lost some of their Maori residents since 1926. The number of Maoris in the remaining towns showed little change, with five exceptions—Auckland, Hamilton, Kaitaia, Pukekohe and Paeroa. The Maoris in these five towns increased at slightly above the average rate of increase for the Maori population of the province as a whole.

It was part of the policy of the state to develop first those areas in which there was already a reservoir of Maori labour for preparing the land for settlement and later for settlement itself. The areas most suitable from this point of view were in fact those in which an unusually large part of the land area was held by Maoris, for the existing concentrations of Maori population were in areas sparsely populated by the pakeha. In short, land development strengthened the ties by which the Maori was held to the land and counterbalanced the disrupting effects of the depression on Maori patterns of economic activity and on their standards of living.

In its broad outlines the distribution of the Maori population remained substantially unaltered in the rural areas of the province. The number of Maoris living on the Volcanic Plateau and on the northern East Coast—areas already characterised by a large Maori population—increased at a rate slightly faster than that in the rest of the province, but so also did the Maori population of Manukau-Franklin and Waikato-Raglan. As a result the ratio of Maoris to pakehas rose in every case except that of the Volcanic Plateau, where the small pakeha population was noticeably augmented by settlers from other parts of the province. The concentration of Maoris on the northern East Coast became even more pronounced; the Maoris in the area now outnumbered the pakehas by two to one. At the same time, Maoris became slightly more important in the Waikato-Raglan area, both in point of numbers and as suppliers of farm produce.[10]

The most significant changes in the distribution of the Maori population since 1926 were essentially local in character and were confined to those areas which benefited directly from land development by the state. In some areas, Maori families were already living on individualised holdings, and in a relatively large number of cases were in fact attempting to utilise at least part of their land. In Northland, where such holdings were often scattered and separated by tracts of wild and unreclaimed gumland, development took the form of assistance to individual farmers. The families affected in this way continued, however, to live in their old homes, so that the actual pattern of distribution of the Maori rural population was not altered, although in other respects the change in the aspect of the land—from grey wastes of scrub to green pasture, from barrenness to productivity—was impressive. In the eastern Bay of Plenty, where extensive tracts were completely under Maori ownership, the land was broken-in under a series of separate 'development schemes'. The work was carried out by the owners under the supervision of trained managers appointed by the Department of Native Affairs. By 1936 most of the land comprised in such schemes along this coast had been subdivided and each family was established on a consolidated and economic holding. A similar policy had been pursued in the King Country, but on a much smaller scale, so that in 1936 most projects were still in the developmental stage, and very few families had been resettled on the land. Unlike those in the rest of the province the people of the northern East Coast had already a tradition of relatively efficient and profitable farming, based mainly on sheep but also more recently on dairy cattle. Dispersed farmhouses, usually in small, loose groups of two or three, had been typical of the landscape for many years. However, a large acreage of land hitherto unutilised was brought into production by means both of large-scale development schemes and of small-scale assistance to individual farmers, so that the characteristic settlement pattern now extended into country that had been dominantly waste.

In all the areas examined so far land development served to reinforce a tendency for movement away from nucleated settlement—a trend already apparent before 1929. In the Ruatahuna Valley and in the upper Rangitaiki Valley (Ngatimanawa), on the other hand, the development of sheep stations under the Native Land Act failed to weaken the characteristic concentration of Maori families in a number of village settlements. In the Rotorua and Waikato areas, land development actually caused a movement out of the lakeshore villages to scattered farmsteads many miles distant. In the Horohoro area, south-west of Rotorua, a large area of continuous tussock grassland gave way to neatly laid-out farms, each occupied and operated by a Maori family. In the Waikato where the Maori holdings available for development were widely scattered, there were rarely more than five Maori farms in any one locality, and those did not necessarily adjoin one another.

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[10] Between 1926 and 1936 the number of Maoris to 100 pakehas rose from 5.68 to 8.42 in Waikato County, from 5.99 to 7.93 in Waipa County and from 27.77 to 29.71 in Raglan County.

In addition to permanent settlements, large camps, in which Maori unemployed were accommodated while breaking in the land, were to be found all over the province. These camps were particularly a feature of Rotorua, the Waikato and the King Country where the land to be developed was not within easy travelling distance of existing centres of Maori population.

## The Situation Today

From 1936 until the present the Maori population has not only continued to increase but has increased at a progressively faster rate.[11] During this period the general distribution of the Maori in the Auckland Province has been affected by the war and, since 1945, by a period of unprecedented prosperity and full employment. Locally the extension of land development has promoted the dispersal of rural settlement.

The most obvious and most widely-discussed result of wartime conditions was the 'drift' of Maoris into the urban centres of the province. Manpower regulations administered by the National Service Division (Department of Labour and Employment) redirected all available labour, both Maori and pakeha, into essential work—into dairy factories and freezing works, canning factories, clothing factories, quarries and lime works. Only rarely, however, were workers sent away from their homes. When the wartime decentralisation of industry failed to extend materially the limited range of employment opportunities to be found in those areas where Maoris were most numerous, large numbers moved of their own accord to the chief towns and cities. This movement was actuated at least in part by patriotic motives but received its main impetus from the high wages offered by urban industrial firms. Since the end of the war, the demand for labour in the urban industries has not abated nor has the movement of Maoris to the source of that demand, although the initial extremely high rate of increase in the number of urban Maoris has not been maintained.[12] In April 1951, 18.85 percent of the Maori population of the Auckland Province resided in its boroughs and town districts, and of this number 6,432, or 41.5 percent of the Maori urban population, lived in Auckland alone. Furthermore, there are, according to preliminary returns for the 1951 census, fourteen towns, apart from Auckland, with more than 200 Maoris. In 1936 there were two, and in 1945 eleven. Even more significant is the fact that six have over 400, and one, Rotorua, has nearly 1500. While the number of Maori urban residents has greatly increased since the nineteen-thirties and shows every sign of continuing to do so, the situation can be seen in its true perspective only when it is appreciated that 66.92 percent of the pakeha population of the province lives in those same urban areas. The popular interest in the influx of Maoris into the towns and cities tends to obscure the fact that over four-fifths of the Maori people are still rural dwellers.

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[11] The annual average percentage increase of the Maori population in the Auckland Province from 1936 to 1945 was 2.3 percent and from 1945 to 1951 2.6 percent.

The changes which have taken place in the distribution of the country-dwelling Maori population in the province as a whole are closely associated with the movement towards urban centres. The total effect has been to distribute the Maoris rather more widely and more evenly, a slight diminution in the percentage of Maoris living in the far north and on the East Coast being balanced by a slight increase in the percentage in certain other areas, notably on the Volcanic Plateau and on the southern East Coast. At the same time their low density in the Thames Valley and in the southern districts of Northland has been maintained (*Figs.* 2 and 4).

In the rural parts of the province there are four areas of considerable extent in which Maori settlement is relatively close and continuous: (a) a belt from the mouth of the Hokianga Harbour to the coast of the Bay of Islands, together with the Pakotai and Pipiwai Valleys and the Whangaruru coast; (b) the valley of the Waiapu River from its mouth to Aorangi, together with the adjacent hill country; (c) a belt between Cape Runaway and Matata[13] on the Bay of Plenty coast, no more than two or three miles wide east of Opotiki, but broadening westward to include Waimana, Ruatoki and Te Teko; and (d) the shores of the lakes Rotorua and Rotoiti together with the Horohoro area.

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[12] Between March 1936 and September 1945 the Maori urban population increased from 4,926 to 11,142 (112.62 percent or an average annual increase of 11.8 percent) and between September 1945 and April 1951 from 11,142 to 15,498 (39.04 percent, or an average annual increase of 6.9 percent).

A large number of Maoris are evenly distributed over the broad valley of the Waipa River between Te Awamutu and Te Kuiti, but the density of settlement is not so great as in the other four areas.

At present Maoris do not live in any number in those parts of the province which are mountainous, forested, or otherwise naturally unsuited to agricultural development. Settlement in such areas is in small, widely-scattered villages located either where physical conditions are most favourable for farming, as in the coastal bays of Coromandel and in the Ruatahuna Valley in the Urewera, or where forestry affords a means of livelihood, as in the Taupo area, in the Rangitaiki Valley, and around Te Whaiti. There are large tracts which are virtually uninhabited by either Maori or pakeha—the Raukumara Range, the Ureweras (except for Ruatahuna and Te Whaiti), parts of the Volcanic Plateau, the dissected hill land of the southern King Country and the interior of the Coromandel Peninsula. Maoris are, however, also notably absent from certain rich and closely-settled pakeha farming districts—those of Maungatapere, Warkworth and Helensville-Kumeu in Northland. The few Maori families who do live in these areas are either concentrated in one or two marginal localities or are scattered singly throughout the district.

Over the rest of the province Maoris are widely though fairly evenly distributed, except for a number of concentrations of limited extent. In the extreme north they are closely settled about the coastal inlets of Whangaroa, Whangape and Herekino, at various points on the Mangonui Peninsula, and in a crescent from Ahipara through Kaitaia to Waipapakauri. Similar concentrations are found on the bayhead plains of the East Coast—Hicks Bay, Te Araroa, Tokomaru, Tolaga Bay and Waipiro—at the southern end of Tauranga Harbour, and around Te Puke and Maketu. Four other localities are also notable for their dense Maori population—Mangere, Pukekohe, Waahi (near Huntly) and Maungatautari (*Fig.* 2).

While no obvious or revolutionary change has taken place since 1936 in the distribution of the Maori rural population, it is true that in general a higher percentage of rural Maoris is today resident in areas which are also densely populated by pakehas than was the case before the war. Proportionately more Maoris are to be found on the Volcanic Plateau, in the Manukau-Franklin area, and on the East Coast south of Tokomaru Bay. The percentage of rural Maoris who are living in Waikato-Raglan and in Northland outside the far north has also risen slightly, although the density of Maori settlement in those areas remains low in relation to both the pakeha population and the land area. The Thames Valley alone has shown no appreciable increase in its rural Maori population since 1936, and, in fact, has fewer Maoris today than in 1945.[14] Proportionately fewer Maoris live in areas where they outnumber pakehas—in other words, the concentration of Maoris in the far north, on the narrow coastal lowland east of Opotiki, and on the East Coast north of Tokomaru Bay, though still remarkable, is less pronounced than it was in 1936. This tendency for the growth of the Maori rural population in those three areas to slow down has become apparent only since the end of the war. During the late 'thirties and in the war years the concentration of Maoris in those areas was accentuated, being reflected in each case by a considerable increase in the proportion of Maoris to pakehas. Since 1945, however, the percentage of the Maori rural population of the province living on the northern East Coast and in the far north has declined. While this has not happened in the case of the eastern Bay of Plenty as a whole, the growth of the Maori rural population has been small between Opotiki and Cape Runaway—an area which is still rather isolated—and, by comparison, little short of phenomenal between Opotiki and Matata. Furthermore, the overall increase in the number of Maoris in the far north conceals the fact that the Maoris around Hokianga and Whangaroa Harbours have been decreasing in number since 1936, and that since 1945 the only increase in the Maori rural population has taken place in the Kaikohe-Moerewa-Kawakawa districts in the Bay of Islands County.

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[13] Matata lies on the coast of the Bay of Plenty some seventeen miles west of Whakatane.

Thus the distribution of the Maoris in the rural areas of the province has been affected by the differential growth of the Maori rural population in various areas. At the same time the proportion of Maoris to pakehas has decreased in some areas and increased in others without any consistent correlation with a slower or faster increase in Maori

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[14] The decrease in the Maori rural population in the Thames Valley between 1945 and 1951 can be explained by the departure of workers from the public works camp at Karapiro.

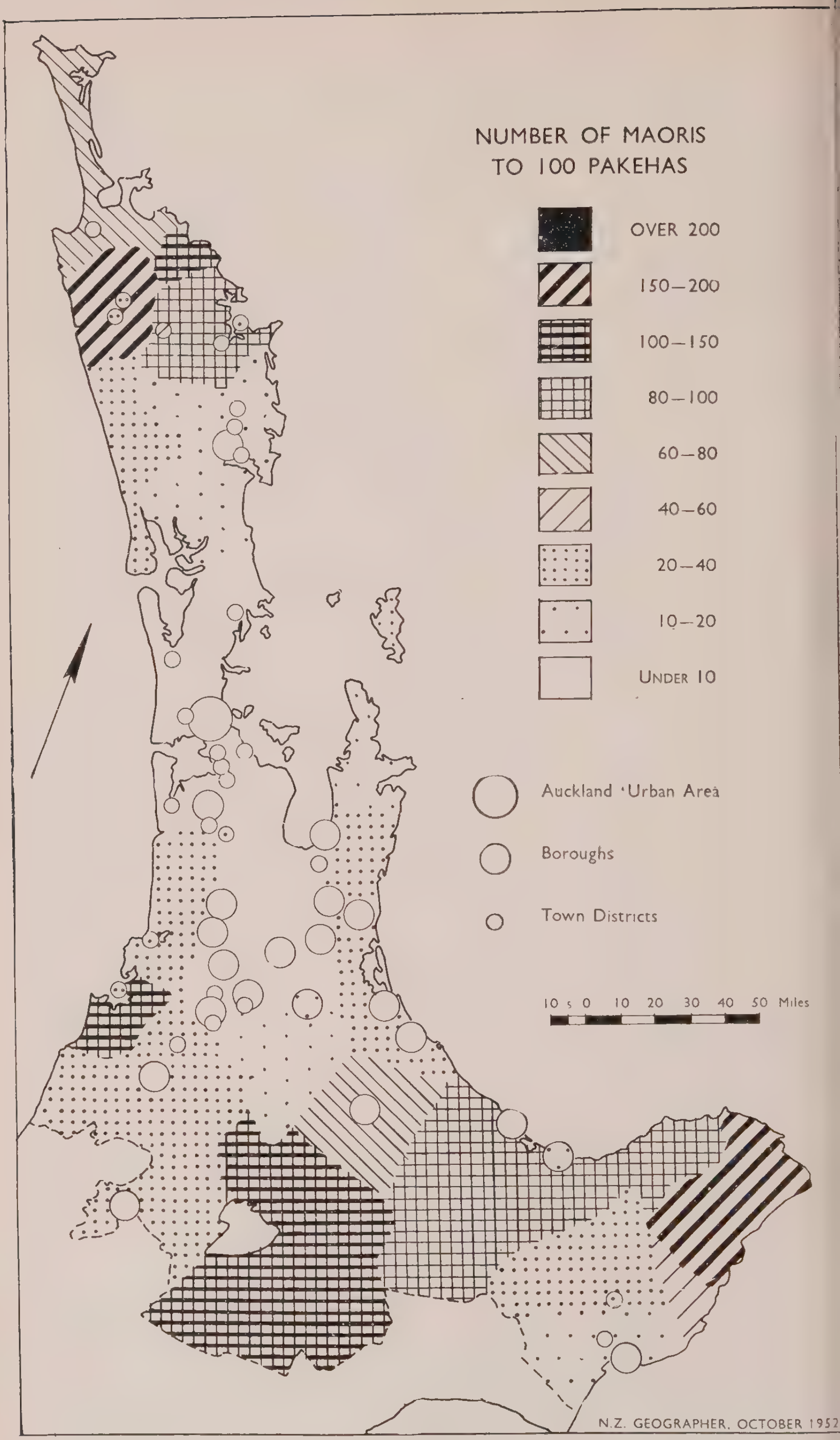

*Fig.* 3. Proportion of Maoris to pakehas in the Auckland Province, 1926. By counties, boroughs and town districts.

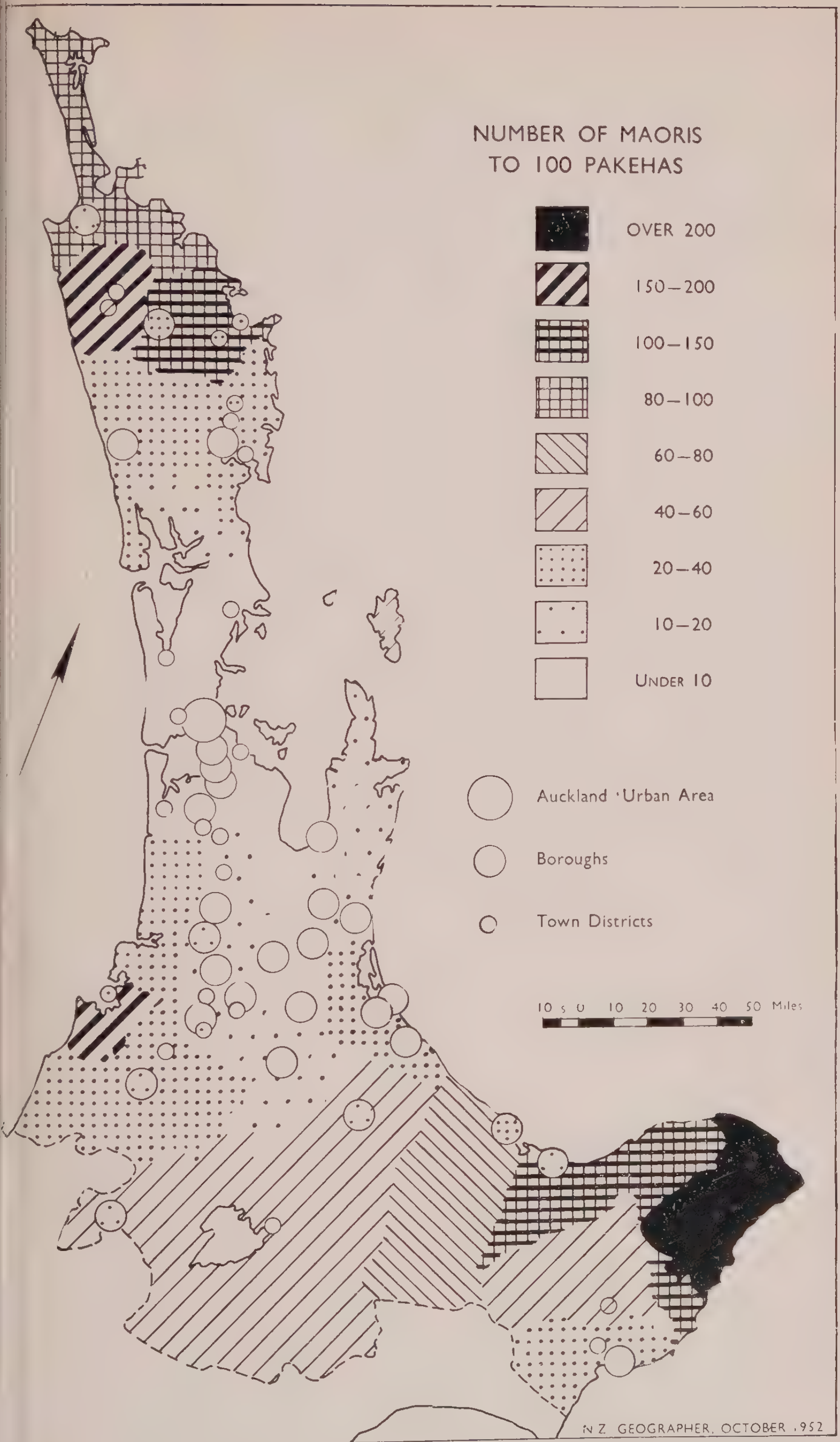

*Fig.* 4. Proportion of Maoris to pakehas in the Auckland Province, 1951. By counties, boroughs and town districts.

population. There are three possible explanations for both phenomena. The first—that the rate of natural increase varies widely from area to area—can be dismissed as improbable, impossible to prove,[15] and incapable of explaining why, for instance, rural Maoris in the Rotorua area today number more than in 1926, 1936 or 1945 and yet constitute a lower proportion of the total population of the area. Secondly, in the case of the Volcanic Plateau and the Bay of Plenty, the drop in the number of Maoris relative to the pakeha population can be partially explained by an influx of pakeha settlers, not only from other parts of the province but also from the rest of New Zealand.[16] Thirdly, the tendency for the rate of increase to remain stable on the northern East Coast and in the far north, and the fact that the proportion of Maoris to pakehas has decreased[17] in some cases where no unusual expansion of pakeha settlement is taking place, can be explained most logically in terms of the movement of Maoris from rural areas to urban centres which began during the war. Apart from the remarkable increase over the last sixteen years in the number of Maoris living in towns and cities, the existence of such a movement is indicated by the fact that over thirty-five percent of the Maoris in the chief towns and cities are between the ages of fifteen and thirty-five, the years at which workers move around most freely. On the other hand in most of the counties which have a Maori rural population of any size under thirty percent belong to that age-group.

## Movement of Maoris to Town and City

Whenever possible Maori workers move to towns within the area in which they live. When that is not possible they prefer to go to the larger centres, not wholly because of the greater opportunities offering there, but in part because they are sure of finding there others from their own part of the country. Hence the main gains have been in the larger regional centres. Rotorua has become the economic focus of most Maoris living on the Volcanic Plateau, Whakatane and Opotiki absorb the landless Maori workers from the rural areas of the

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[15] The rate of natural increase is available in census publications only for the Maori population of New Zealand as a whole.

[16] Although the Maori population of the Auckland Province increased by 15.63 percent between September 1945 and April 1951, the pakeha population increased by 16.27 percent over the same period with the result that the number of Maoris to pakehas in rural parts of the province dropped from 31 : 100 to 30 : 100.

[17] The proportion of Maoris to pakehas has decreased since 1936 in eight counties: Whangaroa, Coromandel, Thames, Piako, Matamata, Tauranga, Rotorua and Taupo; and since 1945 in eight others: Mangonui, Hokianga, Bay of Islands, Whangarei, Franklin, Whakatane, Opotiki, Matakaoa.

Bay of Plenty. Tauranga's industries also employ many Maoris although in this case few live within the borough limits. In at least two areas where the Maoris are numerous in proportion to both land area and to the pakeha population, however, Maoris regularly migrate to outside towns. On the northern part of the East Coast, this outward movement is due to the absence of an urban centre within the area. The far north has six urban centres, but none is large, and the industries of each are few and restricted in size and output. Both Te Kuiti and Gisborne, regional centres for the King Country and the East Coast respectively, more than doubled their Maori population between 1936 and 1945. However, while the number of Maoris in both centres has since continued to increase fairly rapidly, neither has an abnormally large percentage of Maori workers and many Maoris from surrounding rural areas seek employment further afield.

The major centres of attraction to Maoris who leave their own districts in search of work are Auckland, Hamilton and Whangarei, all three of which lie in areas where the population is predominantly pakeha. Auckland draws Maoris from all over the province but especially from the East Coast and North Auckland. Whangarei attracts Maoris from all over Northland but rarely from south of Auckland. Hamilton's sphere of influence in this respect extends over the Waikato and the King Country.

At this point it is important to remember that not all Maoris who seek employment in the towns live within the borough limits. In large regional centres especially there is a daily inward movement of Maoris from their homes in adjacent rural localities. Such daily migrations of workers are a feature of Auckland, Whangarei and Hamilton, and also of Kaitaia, Kaikohe, Tauranga, Whakatane and Opotiki.

Apart from the regional and industrial centres there are only three towns with over 250 Maoris: Ngaruawahia, important primarily as the home of the Maori King, but giving ready access to the coal mines of Pukemiro and Rotowaro and to the Horotiu freezing works; Pukekohe where market gardeners within the borough provide accommodation for the large number of Maori workers they employ; and Taumarunui, the centre of the timber industry of the King Country.

Of the remaining boroughs and town districts in the province there are twenty-three in which the increase of the Maori population since 1936 has been low or negative. These twenty-three fall into five groups according to their location: (a) the main towns of the Thames

Valley—Thames, Paeroa, Te Aroha, Morrinsville and Matamata; (b) the towns of the western Bay of Plenty—Tauranga and Te Puke; (c) the towns of the central and southern parts of Northland, with the exception of Whangarei, Dargaville and Hikurangi—Warkworth, Henderson, Helensville, Kamo and Onerahi; (d) the small towns of the Waikato, such as Te Kauwhata; and (e) the small towns of Manukau and Franklin Counties, such as Waiuku and Howick.

When the distribution of the Maori urban and rural population is viewed as a whole, it appears that in densely-populated areas where there are large urban centres a high proportion of the Maori population (over 18.85 percent) is resident in those centres, provided that farming is not the most important single occupation among the Maoris of the area. Such is the case in the central district of Northland, in the districts directly tributary to Auckland, in the Waikato and on the southern East Coast. Once again, however, the Thames Valley is exceptional in this respect for less than ten percent of the Maori population in that area resides in the five main townships. So also is the western Bay of Plenty—Tauranga, Mt. Maunganui and Te Puke together have less than 120 Maori residents. Rotorua, with 1444 Maori inhabitants, accounts for one third of the Maoris living in Rotorua County. Although farming is important in that area, it supports fewer families than forestry and the tourist trade, both of which are centred on Rotorua.

The size of the Maori urban population in any area rests, in the final analysis, mainly on the range and nature of employment available in the towns and on the pressure upon the resources of the land in the surrounding rural areas. In those parts of the province which have a considerable Maori population, a relatively large acreage of Maori land, and at least one urban centre of major size (the King Country and the eastern Bay of Plenty), the degree of urbanisation is approximately the same as the average for the province as a whole. In other words, approximately one sixth of the Maori population are urban residents. The small number of urban Maoris to be found in the far north, in the Urewera, on the Volcanic Plateau (excluding the Rotorua area) and on the northern East Coast must not be interpreted as indicating that opportunities of rural employment are sufficient in number and range to satisfy the demand. Rather it is to a large extent the result of the absence of urban centres in those areas or of their small size.

## Local Distribution Patterns

During the last sixteen years, the dispersed type of settlement associated with farming has become more or less general in areas where there is plenty of Maori land of good quality, largely as a result of state development of Maori land. In districts where a number of Maori families is engaged in farming the only features which are not typical also of a pakeha farming district are the meeting house and the tendency for two or three farmhouses to be grouped together. Dispersed farm settlement is the rule to the north of Tokomaru Bay on the East Coast, along the Bay of Plenty east of Matata, and throughout Northland. With the extension of land development by the state to most parts of the province (nowadays mainly in the form of assistance to individuals), Maori farmers have become more numerous in the southern parts of Northland and in the bays along the Coromandel coast. Others, near Tauranga and on the southern East Coast, have turned their small holdings into market gardens or intensive dairy farms, producing maize, flowers, vegetables and small amounts of butterfat. In these cases houses are not widely dispersed because of the small acreage of the holdings. In the King Country, on the other hand, holdings are by comparison often quite large and since in most cases the family resides on its land, the settlement pattern is dispersed, although the holding itself is as a rule under only partial cultivation, and is often inefficiently farmed at that.

The rural settlements of Maori and pakeha are by no means mutually exclusive, except for the occasional *pa*. Some districts are farmed entirely by Maoris, more especially those developed within the last twenty-two years by the state—for example, Horohoro (Rotorua), Te Kao (Mangonui) and Te Kaha (Opotiki). In others Maoris and pakehas own adjoining farms, as in many parts of Northland, around Whakatane and in the Waikato and the King Country. Throughout he province Maori families not directly connected with the land live nterspersed amongst pakehas in small rural centres and on the fringes of the larger towns. This type of settlement is characteristic of the outhern East Coast where many of the families concerned have an nterest in tribal land used as sheep country.

It is only in areas where farming is not a major activity of the Maoris nd where employment for wages can be readily obtained within easy each of settlements that the traditionally-nucleated *pa* still survives. The *pa* is probably best developed today along the shores of the lakes

Rotorua and Rotoiti, on the Volcanic Plateau, and in the Urewera at Te Whaiti and Ruatahuna. In the two latter areas contact with the pakeha has been more recent than in the rest of the province, and in all three the principal types of employment (those connected with the tourist trade and forestry) lend themselves readily to nucleated settlement. A few similar settlements are found in areas where most of the land has been occupied by pakehas for some decades, and the Maoris live mainly by working as labourers in primary and secondary industries—as in the Waikato and Thames Valleys, in the vicinity of Opotiki, and around Gisborne.

Despite the more or less complete disappearance of the traditional form of Maori settlement, the meeting house remains the essential focus of every Maori community. Apart from temporary public works camps and the bush camps at Waipoua and Tairua, only two areas with a large Maori population have no meeting houses, Auckland and Pukekohe. At present the Auckland Maori Community Centre is doing its best to unify the heterogeneous tribal elements in the city; the lack of a meeting house reflects the imperfect realisation of the concept of Ngati Akarana, a new tribe whose membership is based on residential qualifications and not on genealogical descent. The labourers on the market gardens of Pukekohe and Patumahoe have no link with the land nor with one another; they have come from many different localities to a district which has not had a *marae* since the wars of the 1860's.

With the exception of some workers in the Pukekohe market gardens every Maori recognises some locality as 'home'. Seasonal and casual workers, no matter how far afield they may travel, usually spend part of their year in the home settlement. The majority of urban dwellers maintain their connection with the rural district from which they came, often returning there when their working days are over; in short, they do not regard the city as a permanent home. During the last ten to twelve years, however, there has grown up a generation of Maori children born and bred under urban conditions. Consequently there exists in the urban centres of the province the nucleus of a Maori population as urbanised as that of the pakeha.

## CONCLUSION

Today, as in 1926, the Maoris are most densely settled in those areas where pakehas are least numerous, but proportionately more Maoris now live in rural areas where they are in the minority. Similarly, while the Maoris in the province are still predominantly rural dwellers, the present Maori urban population forms a larger part of the total Maori population than at any previous date, and Maori workers from most parts of the province are arriving daily in the larger urban centres, especially those in which the industrial functions are well developed. Meanwhile, in the country, dispersed settlement has become as characteristic of the Maori population as of the pakeha, although a small number of notable exceptions exists.

There is every indication that the Maoris will continue to move into the towns and cities provided that present economic conditions are not substantially altered. This can be inferred directly from the fact that the rate at which the Maori urban population is increasing is still nearly three times that of the Maori population of the province as a whole. Several factors favour the maintenance of this trend. The size of the Maori urban population is not large in itself but only in comparison with that of sixteen years ago. Even at the present high rate of increase it will be many years before the Maori become as urbanised as the present pakeha population. Pressure on their land resources, one of the basic causes for the movement away from rural areas, will become greater in the future, because the Maori are increasing at a progressively faster rate. If the rate of land development were accelerated and all possible steps taken to raise the productivity and carrying capacity of Maori land, it is possible that the 'drift' might be checked. There are at least three major reasons why it could not be halted completely. Firstly, it is questionable whether there is enough Maori land to be developed to support a much larger percentage of the Maori population than at present. Secondly, in some areas Maori land is useless from an agricultural point of view and farming is consequently not the dominant activity among the Maoris, nor is it likely to become so. Thirdly, even if it were possible for nine out of ten Maoris to live in the country without a drop in their standard of living, Maori workers would not necessarily cease to leave the land since they are also actuated by a desire to seek employment in a less restricted field and to take advantage of the superior educational and social facilities of the towns. They might, however, be discouraged from migrating to towns and cities if the present demand for labour in the urban industries should diminish or cease, or if wages were no longer high enough to persuade them to break their ties with birthplace, kinsfolk and ancestral land. Decentralisation of industry to rural townships and subregional centres would possibly have much the same effect.

Since urban centres are lacking or restricted in size in those areas where Maoris are densest and the proportion of Maoris to pakehas highest, it is inevitable that, if the surplus Maori population continues to move to towns and cities outside these areas, the percentage of the total Maori population there will continue to diminish, thus reinforcing the trend towards a more widespread distribution of the Maori population as a whole. Locally the dispersal of Maori rural families is already far advanced. The remaining nucleated settlements, with the exception of those connected with forestry, will probably also disappear eventually, if and when more land at present undeveloped becomes ready for settlement and as those Maoris not closely associated with the land seek work in urban areas.

These trends, which have brought Maori and pakeha into closer contact, not only in the towns but also throughout the province, have inevitably given rise to new problems. The most obvious and most dangerous of these problems from the point of view of the relations between the two peoples are those arising out of the influx of Maoris into urban areas. The acute housing shortage and the high price demanded for accommodation have forced the majority of Maoris to congregate in the poorer parts of most towns, where overcrowding and inadequate sanitary arrangements endanger their health and standards of living.

In rural areas the problem is not so much one of adaptation as of the maintenance and improvement of the standard of living. The first step towards an answer to this problem should be the full development and efficient utilisation of all productive or potentially productive Maori land. This is also essential if satisfactory relations are to be maintained between Maori and pakeha farmers, for Maori farmland which has been allowed to revert to scrub or to become infested with noxious weeds is a menace to adjacent farms and an important cause of friction between Maori and pakeha.

Yet because the Maori can make an important contribution to the national economy, not only as farmers and workers in rural industries, but also in every other class of occupation, it is imperative that the present problems arising out of their rapid expansion in numbers and out of changes in their distribution should be resolved.

# PHOSPHATES IN NEW ZEALAND AGRICULTURE

M. M. BURNS

IN SIZE and population New Zealand is a small country but in food production per acre of farmed land, in output per worker on the land, and in volume of surpluses of food for export New Zealand ranks among the major countries of the world.

The dominion's success and achievement as a surplus-food producer is due to a favourable climate for pastoral farming, to an enlightened and conscientious rural population, and to the sound work which has been done in agricultural research and by the extension services. All three of these factors are combined particularly in one facet of the dominion's agriculture: the use of phosphate fertilisers. Indeed, the outstanding and almost universal increases in the productivity of the land which have followed from the use of these fertilisers is one of the most striking features of New Zealand agriculture.

In New Zealand, which is agriculturally barely a century old, farmers early realised the importance of the phosphate fertilisers. The first shipment of phosphates was landed in 1867, the first superphosphate in 1880; the first local fertiliser made was bonedust at Timaru in 1878, and the first chemical works to manufacture superphosphate was established at Burnside in 1882, followed by a second unit at Westfield in 1887.

From these small beginnings have developed an annual importation of over 80,000 tons of fertiliser and a domestic fertiliser industry with eight major units which manufacture annually nearly 800,000 tons. Of the combined totals not less than ninety percent is phosphate fertiliser. Although the proportions of nitrogen and potash fertilisers are increasing slowly, the dominance of phosphates is the most striking feature of fertiliser use in New Zealand. This is clearly shown in Table I in which the ratios of the three major plant nutrients applied in fertilisers are given for a number of countries.

The unusual situation in New Zealand is due in part to the dominant position of an all-the-year-round pastoral farming with which is associated high nitrogen fixation in the clover components of the pastures and high cyclic returns of both nitrogen and potash in the excreta of the grazing animals. It is also due in part to the unusual characteristics of the most widespread and characteristic soil types. Basically this second factor is the more important.

## Characteristics of New Zealand Soils

The soils of New Zealand are derived from a wide range of parent materials, many of which are naturally low in minerals containing phosphorous compounds, while parent materials of volcanic origin which are rich in readily-weathered minerals containing iron compounds unfortunately have the capacity to form insoluble combinations with phosphates. This rather widespread inherited character of low available phosphate levels in the soils was accentuated in the older free-draining soils of the high rainfall areas by the acid leaching solutions derived from the litter of the evergreen forests. These influences have produced over most of the country the characteristics of medium to low available phosphate levels (Table II) and, in many cases, of low lime levels.

TABLE I

Ratios of Plant Nutrients in Fertilisers used in Various Countries in 1949

| *Country* | *Ratio of* *Nitrogen* to | *Phosphate* to | *Potash* |
|---|---|---|---|
| United Kingdom - - | 1 | 2.3 | 1.1 |
| Netherlands - - - | 1 | 1.0 | 1.1 |
| Germany - - - | 1 | 1.1 | 2.4 |
| Denmark - - - | 1 | 1.4 | 1.5 |
| Sweden - - - | 1 | 2.2 | 1.0 |
| U.S.A. - - - | 1 | 2.1 | 1.1 |
| New Zealand - - - | 1 | 46.0 | 1.3 |

Although soil maps show very many different soil types, the characteristics noticed above are common to many types, and this has made it possible widely to adopt relatively simple phosphating and liming programmes in order to establish and develop good pasture. Following the applications of fertilisers at the time of first breaking-in the land, the regular use of phosphate and lime to maintain an available supply is all that is necessary, because the excreta of grazing animals and the roots of the pasture plants are most effective builders of soil fertility. Good pastures heavily stocked and regularly topdressed have raised the fertility of millions of acres of New Zealand's farmlands until their present productive capacity is many times that which they had

TABLE II

AVAILABLE PHOSPHATE STATUS OF NATURAL NEW ZEALAND SOILS*

| *Phosphate Level* | *Percentage of Available Phosphate*** | *Representative Soil Types* | *Proportion of Farming Land and Main Areas Represented* |
|---|---|---|---|
| Very high<br>.05 % | .080<br>.050 | Middlehurst silt loam<br>Amuri clay loam | Less than 1 percent<br>Mainly round Oamaru and Waikari |
| High<br>.031-.050% | .049<br>.040<br>.032 | Egmont sandy loam<br>Tai Tapu silty clay loam<br>Pawson silt loam | 12-15 percent<br>Eastern slopes of Southern Alps<br>Central Otago and along rivers |
| Medium<br>.016-.030% | .028<br>.025<br>.022<br>.019<br>.016 | Tasman silt loam<br>Becks sandy loam<br>Tirau sandy loam<br>Takahe silt loam<br>Waimarino sandy loam | About 40 percent<br>Central North Island<br>Coastal Taranaki<br>Western slopes of the Southern Alps, much of it steep and forested |
| Low<br>.005-.015% | .015<br>.012<br>.010<br>.009<br>.005 | Kaharoa medium sand<br>Clydevale silt loam<br>Lismore silt loam<br>Raukawa silt loam<br>Waiotira clay loam | About 40 percent<br>East coast areas of both islands and Southland |
| Very low<br>.005% | .003<br>.002<br>.002 | Waikare silty clay<br>Pukekauri clay<br>Hope sandy loam | About 8 percent<br>Mainly in Northland |

*Data supplied by the Soil Bureau, Department of Scientific and Industrial Research.

**Phosphate extracted from soils by a two percent solution of citric acid under standard conditions is often termed 'available phosphate'.

in their natural state. Indeed, these practices have undoubtedly achieved the building-up of soil fertility in naturally poor soils more rapidly than anywhere else in the world.

The simple programme of liming, sowing, phosphating and stocking, although it can be widely used, is not universally necessary. Many soils do not need lime, a few do not need phosphates, while some need potash—particularly the peats—as well as lime and phosphates for normal plant growth. Trace nutrients are also important on some soil types. Cobalt and copper, though not needed for pasture growth, must be present in the herbage for the health of stock. The importance of cobalt on many of the pumice soils and of copper on the peats is well known and some indication of how great an area is affected can be gained from the fact that over 40,000 tons of cobaltised fertilisers and 5000 tons of copperised fertilisers are used in the Auckland Province each year. Included in the cobaltised fertiliser tonnage is that needed to bring in the 20,000 acres of new pumice land developed each year by the Department of Lands.

## Phosphate Fertilisers used in New Zealand

The main phosphate fertilisers used in this country are superphosphate and its related products which are manufactured locally, and basic slag and ground rock phosphate which are imported. About 1930 small amounts of concentrated phosphates were imported and small tonnages of similar products are again coming into the country.

Superphosphate has proved an effective fertiliser under nearly all soil and climatic conditions though heavy initial applications of lime greatly increase its effectiveness on very acid soil types. Lime-reverted superphosphate has been used widely on forage crops and pastures in the South Island and serpentine superphosphate, introduced during the war, has gained steadily in favour over recent years in dairying districts. Basic slag has long been favoured, especially on heavy acidic soils in the high rainfall districts, but supplies have become increasingly difficult to obtain as a result of decreased production and increased consumption in European countries. Finely ground rock phosphate is also used to some extent, alone or in mixtures with superphosphate, especially in Northland and in Southland.

The general picture of fertiliser supplies as used in the 1948-1949 season is expressed clearly in Table III.

During the recent war, fertiliser production was severely curtailed, plant renewals were delayed, and planned additions to works to increase output were postponed. Since 1945, and in spite of serious supply and construction difficulties, manufacturers have undertaken extensive plant renewals and added to their prewar production capacity while at the same time output of fertilisers was increased to record levels in 1951. Even so, production has not been able to keep up with the accelerated demand stimulated by years of short supplies, the intensification of land development and increased prices for farm products, especially wool. This has been most marked in the southern half of the North Island and the position in this area will remain difficult until additional manufacturing capacity is brought into production.

## Raw Materials

The whole of the domestic phosphate fertiliser industry is based on superphosphate made by treating ground rock phosphate with sulphuric acid produced by burning elemental sulphur.[1]

The main raw materials used by the industry in 1949 are set out in Table IV.

All the rock phosphate now comes from Nauru and Ocean Island in the Pacific but there was a period during the war and afterwards when supplies came from many sources: Florida, Egypt, North Africa, Makatea and various other Pacific islands. Although before the war some sulphur was imported from Japan, the major part then, and now the entire supply, is obtained from the Gulf Coast of the United States.

Since 1949 all works have expanded their productive capacity and are capable of using up to 85,000 tons of sulphur and of treating nearly 500,000 tons of rock each year. This programme for increased fertiliser output has been checked by the present world shortage of sulphur, and in 1951 regulations were introduced requiring all superphosphate manufactured in this country to be mixed with twenty-five percent of ground serpentine or limestone, alone or in mixtures with rock phosphate. The allotment of sulphur to New Zealand in 1951 was 66,000 tons, the fertiliser production from which was sufficient to meet maintenance applications on developed lands, but did not meet requirements for land development and for the aerial topdressing of the rolling hill country.

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[1] One ton of sulphur yields about 4.3 tons of 69 percent sulphuric acid and 8.7 tons of superphosphate. This acid and ground rock are mixed in calculated proportions and yield superphosphate which is a mixture of approximately 35 percent monocalcic phosphate and 50 percent calcium sulphate. The remainder comprises moisture, unreacted rock and impurities derived from the rock.

### TABLE III

### MAIN FERTILISERS USED IN NEW ZEALAND, 1949

(Approximate Tonnages)

| *Fertiliser* | *North Island* | *South Island* | *Total* |
|---|---|---|---|
| *Manufactured* | | | |
| Superphosphate | 334,000 | 112,000 | 446,000 |
| Serpentine Super | 129,000 | —— | 129,000 |
| Cobaltised Super | 37,000 | 9,000 | 46,000 |
| Cobalt Serpentine Super | 10,000 | —— | 10,000 |
| Lime-reverted Super | —— | 20,000 | 20,000 |
| Copperised Super | 5,000 | 2,000 | 7,000 |
| Potassic Super | —— | 1,000 | 1,000 |
| Fused Slag* | 20,000 | —— | 20,000 |
| *Imported* | | | |
| Basic Slag | 37,000 | | 37,000 |
| Ground North African Rock Phosphate | 43,000 | | 43,000 |
| Potash Fertilisers | 6,000 | | 6,000 |
| Nitrogen Fertilisers | 2,000 | | 2,000 |
| *Organic* | | | |
| Meat Industry By-products | 30,000 | | 30,000 |
| *Others* | 3,000 | | 3,000 |
| | Approximate Total | | 800,000 |

*Now out of production.

### TABLE IV

### RAW MATERIALS USED IN PHOSPHATE FERTILISER MANUFACTURE IN NEW ZEALAND, 1949

| *Material* | *Approximate Tonnage* | *Rate per Ton of Fertiliser* |
|---|---|---|
| Rock Phosphate | 400,000 | —— |
| Sulphur | 70,000 | —— |
| Nitrate of Soda | 3,000 | —— |
| Borax | 200 | 56 pounds |
| Copper Sulphate | 175 | 50 pounds |
| Cobalt Sulphate | 150 | 6 pounds |

The close relationship of fertiliser use to the pastoral industries, especially to the dairy industry, is shown in Table V. Naturally all rable crops and nearly all supplementary feed crops are sown with hosphates but as most of them are grown in the drier districts of the outh Island the quantities of fertiliser used are less than those used on pastures in the North Island (*Fig.* 1).

If 90,000 tons of phosphate fertilisers are allowed for sowing with crops in South Island mixed crop-livestock farming areas about 567,000 ons are left for the topdressing of pastures. This works out at an average dressing per acre of three hundredweights in the North Island and one and a quarter in the South Island. The North Island with eighty-seven percent of the dominion's cattle, accounts for eighty-two percent of the pasture topdressed and for the use of over eighty percent of all fertilisers used.

TABLE V

APPLICATIONS OF PHOSPHATE FERTILISERS IN NEW ZEALAND

(1940-1941, taken as a 'normal' year)

| | |
|---|---|
| Pasture Area (in acres): | |
| Native Pasture | 13,861,000 |
| Sown Pasture | 17,725,000 |
| Total | 31,586,000 |
| Area Topdressed (in acres): | |
| North Island | 3,674,582 |
| South Island | 723,763 |
| Total | 4,398,345* |

*This is one quarter of New Zealand's sown grassland.

The bulk of the fertiliser is still used on the low country, but increasing quantities are now being applied to the hill country. This can be divided broadly into two classes: country which warrants development by the owner on the basis of increased production; and country which does not warrant treatment on the basis of increased production alone, but may do so in the more general interests of production plus conservation and flood control. It is on the first class of country—the country which is good enough to carry the development costs—that the light planes as seed sowers and aerial topdressers have made such a promising start. Like all new projects the light-plane operations have run into difficulties, but the principle is sound; the work of operators is good and they are making a major contribution to primary production by the aerial distribution of fertilisers or hill country.[2]

The second class of country presents a much more controversia series of problems, but here also the key to pasture restoration is the application of phosphate fertilisers from aeroplanes. The Soil Bureau has estimated that there are at least nine million acres of hill country which would benefit from topdressing, and of this area at least four million acres are certain to give really worthwhile results. This is in itself a firm reserve of potential agricultural production in New Zealand.

In addition to their use in agriculture, fertilisers are extensively used in horticulture; that is, in the market-gardening and fruit-growing industries. These, though small in acreage, are expanding; and as a group the market gardeners are heavy users of fertilisers when considered in terms of rates per acre. They also tend to use large quantities of the more expensive organic fertilisers from the meat industry; and some groups, especially the tomato growers and tobacco growers, use much of the potash which is imported. Horticultural users who do not have the benefit of pastures and stock to maintain soil fertility use ratios of nitrogen, phosphate and potash in their fertilisers which are much nearer those of the older and more densely populated countries. However, the ratios are not nearly so well organised in relation to the soil, the crop and its maturity as are those used overseas, and much improvement can be made in these directions.

## PHOSPHORUS IN SOILS

Phosphorus in soils occurs in many different combinations which may be grouped into three main classes: inorganic forms, organic forms and the phosphorus in living organisms.

In the inorganic compounds the phosphorus is combined with lime, magnesium, iron, aluminium and the clay minerals. Phosphates combined with lime and magnesium are generally regarded as being available to plants while those with iron, aluminium and clay are much less available. Indeed, a high percentage of such combined phosphates are considered to be fixed and unavailable.

The organic compounds are those present in plant and animal residues and the products of the soil organisms. These phosphate compounds are now recognised as being important, especially under systems

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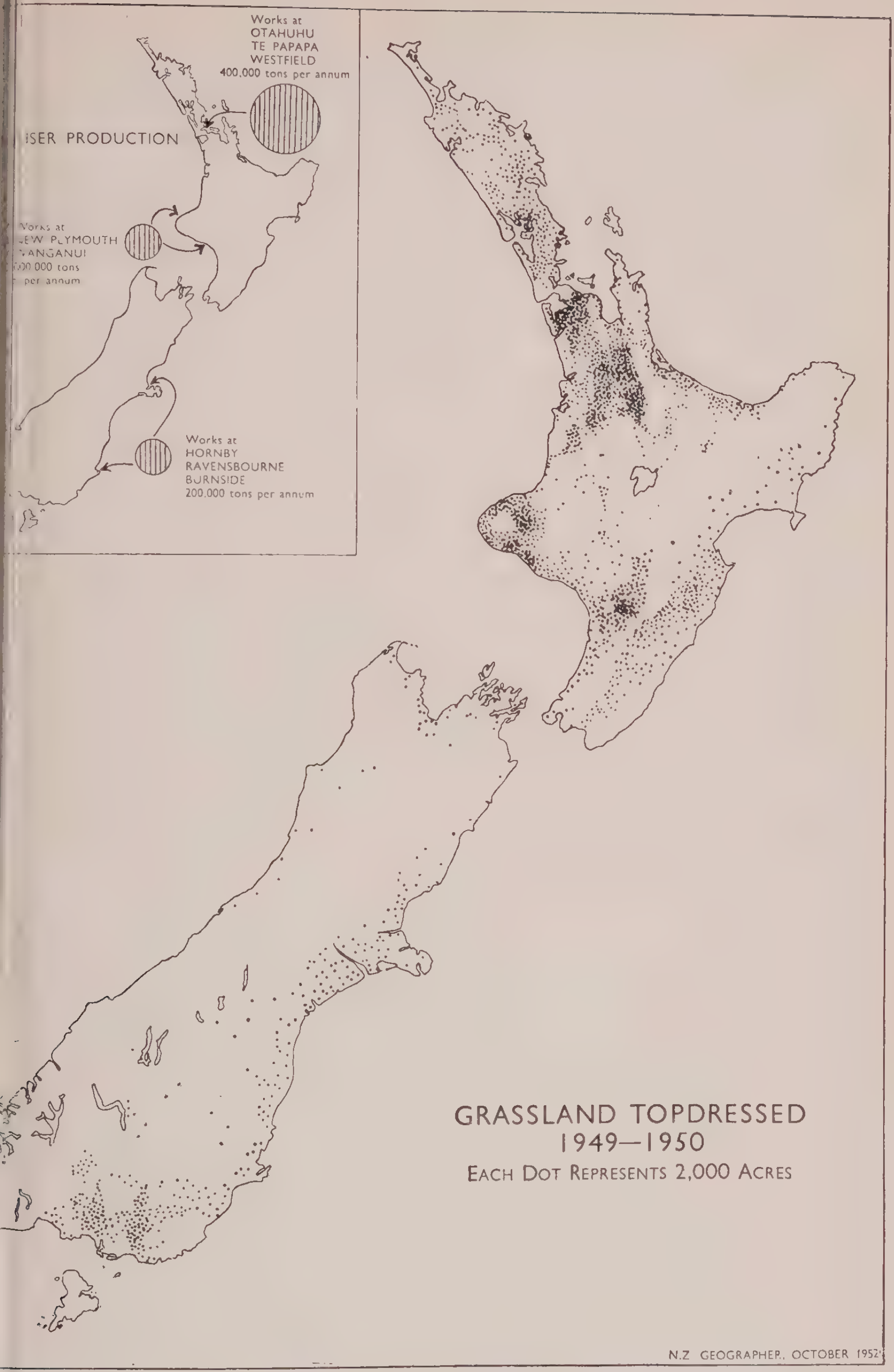
[2] Light-plane operators applied 45,000 tons of fertiliser to 429,000 acres in twelve months' operations during 1950–1951.



N.Z. GEOGRAPHER, OCTOBER 1952

*Fig.* 1. Maps showing the distribution of artificial fertiliser production and use in New Zealand. Distribution of topdressed land after map by Kenneth B. Cumberland (see *Geogr. Journ.*, Vol. 112, Nos. 1-3, July-September, 1948, Fig. 2, p. 47), data from the Government Statistician. Fertiliser production from data made available in generalised form to the present author.

of pastoral farming where there is a heavy annual return of phosphates in the dung of grazing animals. In some heavily-grazed soils the proportion of phosphate in organic combinations may be up to eighty percent of the total amount present. The actual availability of this phosphate to the plants depends largely upon the activity of the soil organisms and it is greatest where they are very active and where there is a high level of soil nitrogen.

The phosphate compounds present in the cells of living organisms can be regarded as linking the other two classes.

The relative proportions of the total phosphorus within each of these groups and of the separate compounds within each group depends upon the particular soil taken and its level of fertility. These relationships are in turn reflected in the crop through the relative amounts present of freely-available, slowly-available and unavailable phosphorus.

The phosphorus in soils passes through a cycle of uptake of available forms by plants, return to the soil in residues or through stock droppings, followed by use and release again by the organisms of decay. There are several weak points in this cycle but the most important is that associated with the fixation of phosphorus in unavailable forms mainly as compounds of iron and aluminium. The rate of progress through the cycle is greatest in slightly acid, fertile soils and slowest in strongly acid soils of low fertility.

## Reactions of Soluble Phosphates added to Soils

The effectiveness of phosphate fertilisers added to soils depends on soil conditions, climatic factors and the crop grown. The recovery by crops of the added phosphate is usually less than it is with added nitrogen or potash. This is due to the fact that soluble phosphates, though not washed out in the drainage, tend to be converted to less soluble forms. This process is often called 'phosphate fixation' and it is probably the most serious problem in the efficiency of phosphate fertilisers and it is the major reason why frequent applications of phosphate fertilisers are required if production is to be maintained at a high level. In this respect the volcanic soils are much more active than are soils derived from other parent materials, a fact which explains their very low content of available phosphate in the natural state, their great responsiveness to added phosphate and their need for regular topdressing with phosphates.

The problem of reducing the rate of phosphate fixation can be approached in many ways though no one method has been proved to be the answer and much investigational work on the problem is in progress. Methods used to reduce the fixation of phosphates can be listed in four groups: (i) by treatment of the soil—that is, liming strongly acid soils; (ii) by placing the fertiliser in the most effective position for the particular crop or pasture grown and possibly by granulation of the fertiliser; (iii) by maintaining active decomposition of organic matter in the soil through the addition of fresh reserves (including green manure crops and stock excreta) and by liming where necessary; and (iv) by using special fertilisers such as basic phosphates—that is, serpentine superphosphate, lime-reverted superphosphate, and basic slag—though this has yet to be proved and is probably dependent on the soil type.

Much more knowledge must be acquired about the actual processes of fixation, including knowledge about physical absorption, chemical precipitation and fixation by organic compounds, before the basic problem of getting more efficient utilisation of added phosphates can be overcome. Aspects of these problems are under investigation at many agricultural research laboratories.

## Future Developments in Phosphate Fertilisers

Although practically all New Zealand soils were so deficient in lime and phosphates that they could be built up to high production by suitable applications of these materials, it is unlikely that this simple programme can be continued indefinitely without modification. Many farmers are getting better results from the use of serpentine superphosphate than from ordinary phosphates, a result which may be due in some cases at least to its content of magnesium. Usually, but not always, these farmers are on farms which have been producing at a high level for years, which lends support to the belief that on many of the well-developed soils a stage has now been reached where the fertiliser programme is going to become more complex if production is to be maintained at the highest levels.

In horticulture the use of fertilisers will certainly extend and greater use will be made of the newer concentrated products such as urea, ammonium nitrate and possibly the ammonium phosphates; but the most significant developments will almost certainly be in the use of fertiliser mixtures to give definite ratios of nitrogen, phosphate and potash for specific soils, specific crops and even for specific stages in the growth of crops.

Moreover, although the rate of growth of exotic timber trees such as the pines may be regarded as outstanding, there is evidence to suggest that many plantations would benefit greatly from applications of phosphate to stimulate their mycorrhizal associations. Perhaps in the future the application of phosphates to the planted forests, especially those on the leached soils and on the younger pumice soils may prove both effective and profitable.

Superphosphate is now the main phosphate fertiliser in New Zealand. The only alternative products are those which are either developed from the normal processes of making superphosphate, such as concentrated phosphates, or those products which can be produced from rock phosphate by fusion with heat in electric furnaces or fuel kilns. The Tennessee Valley Authority has been experimenting intensively on the latter group of phosphate fertilisers for many years and it has done some really outstanding work. Even so, in the United States where electric power, fuel oil, natural gas and coke are freely available in quantity and at low prices, the fusion phosphates account for less than five percent of the total output of phosphate fertilisers. This percentage will certainly increase, and New Zealand with a potential surplus electric power—and it appears likely to remain as a potential surplus for quite a few years—must follow closely the work on these products of T.V.A. But superphosphate, as now made from sulphuric acid and rock phosphate, will remain the chief phosphate fertiliser for many years because of its cost and its effectiveness as a fertiliser. There may be developments in processing, conditioning and in distribution, but major changes in the types of phosphate fertilisers used are not likely for many years and when they are adopted they will be fertilisers based on the use of hydroelectric power in manufacture.

There will be a steady increase in the output of special mixtures containing potash and nitrogen while serpentine superphosphate and phosphates containing trace nutrient are certain to increase in importance. Then, too, there is the possibility of special mixtures containing DDT and Gammexane being developed for the control of grass grub and other insect pests of pastures, and of mixtures containing the hormone weedkillers for pasture improvement.

## Conclusion

New Zealand is a country with many diverse soil types which tend to occur in areas intermingled irregularly. Nevertheless, their outstanding characteristic is a deficiency of available phosphate which has made possible the building-up of the productive capacity of millions of acres of different soil types by a combination of pasture establishment, phosphate topdressing and pastoral farming. There are thousands of acres of low country still to be developed, such as the podsolised gumlands of North Auckland and the gently rolling pumice lands of the central plateau. There are also great areas of peatland to be reclaimed and millions of acres of low hill country to be restored and maintained. Only a small amount of what may be regarded as the developed lands, are at, or even near, their peak production. The most certain development in New Zealand agriculture will be a steadily increasing demand for phosphate fertilisers. These will be used alone, or with lime, on most of the country which is being developed to full production; and there will be a steady increase in the complexity of the fertiliser programmes for use on the older and more intensively farmed areas where potash, nitrogen and, in some cases, the trace nutrients are assuming increasing importance.

It is now well known that phosphate fertilisers are effective and that they are the real basis for soil-fertility building by pastoral farming. However less is known of the reasons why this is so. Investigations of the phosphate cycle, of the reactions of phosphates in the soil, of their uptake by plants, followed by mobilisation by animals and later by the soil organisms will in future continue to represent a major field of scientific work in New Zealand.

# NEW ZEALAND MOSAIC MAPS

D. W. McKENZIE

THE SHEETS of the series of topographic maps of New Zealand on a scale of one inch to the mile are continuing slowly to appear, their quality improving as time goes on. Maps on a scale of 1 : 25,000, however, are few in number and restricted in range, though for some of his purposes they are often of much greater value to the geographer. With the small resources of this country it is difficult to envisage their production to an extent that will provide anything like an adequate coverage of the country for a long time.

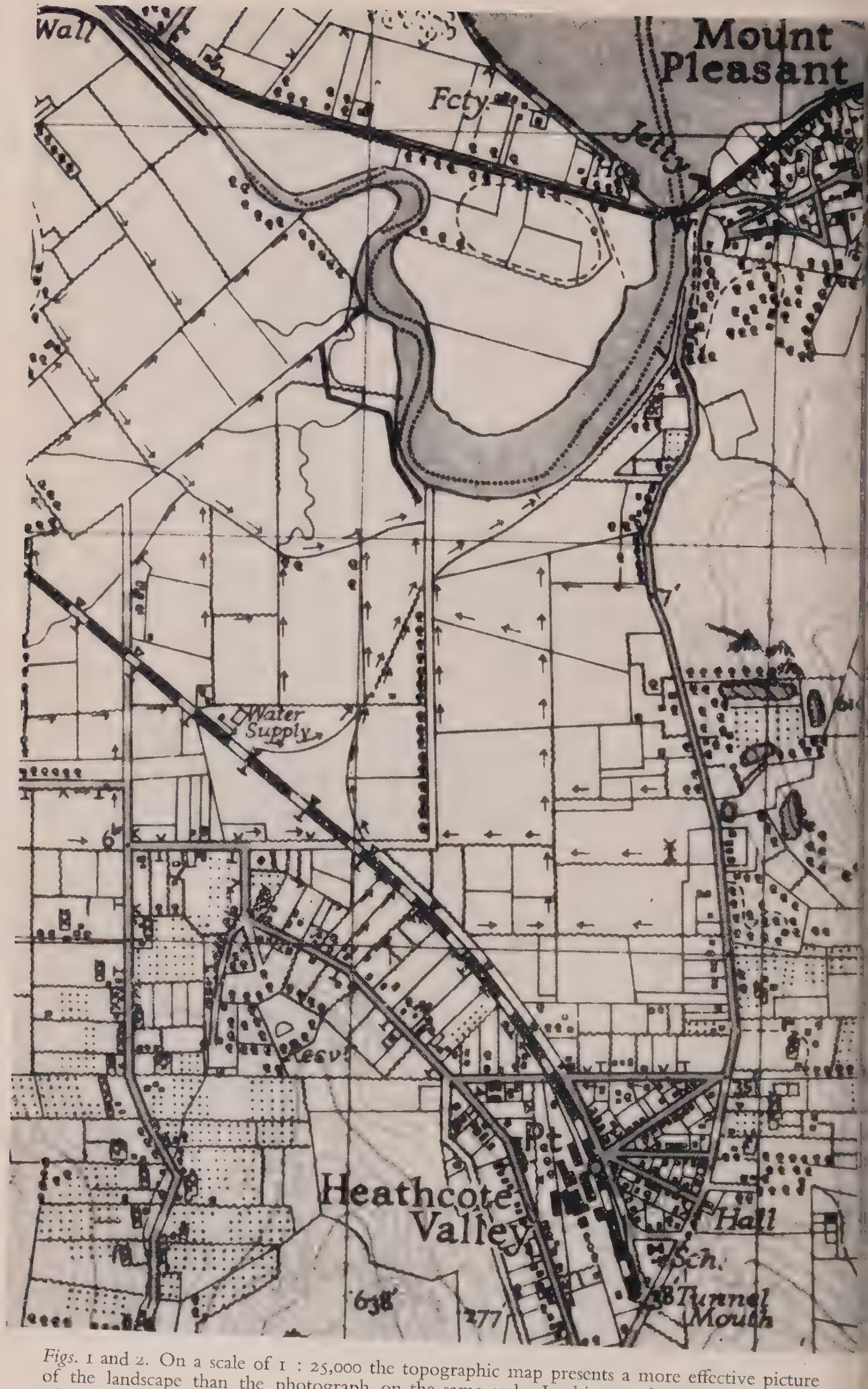
In these circumstances the Department of Lands and Survey has begun the production of what it calls the New Zealand Mosaic Map Series on scales of 1 : 15,840 (4 inches to 1 mile) and 1 : 25,000 (2.52 inches to the mile), each sheet appearing on both scales. These are semicontrolled mosaics of aerial photographs with the national grid and a certain number of names superimposed in white. They are fully titled and scaled in the general format of a topographic map, and are reproduced photographically on heavy paper with bound edges. The sheets and sheet numbers of the mosaics are the same as those of the 1 : 25,000 topographic map series; thus nine of them will cover one sheet of the inch to the mile map. Since these mosaics are produced much more quickly than a topographic map, and since it is the intention of the Department of Lands and Survey to extend more widely the use of mosaics in areas where it is obvious that 1 : 25,000 maps will not be produced for very many years, geographers must examine them carefully and assess their values and uses.

It is first clear that the aerial photograph, or the mosaic made from it, is not, and can never be, a map. Each photograph suffers from distortion away from what may be regarded as the centre of the photograph, and though the cutting of overlapping photographs in the mosaic is designed to minimise this, it can never eliminate it. The map, within the limits set by surveying, draughting, printing, paper and map projection is designed to be correct in either area or direction, or to be a compromise between the two. What distortions it has are continuous and measurable in contrast to the discontinuous and variable distortion of a series of overlapping aerial photographs.

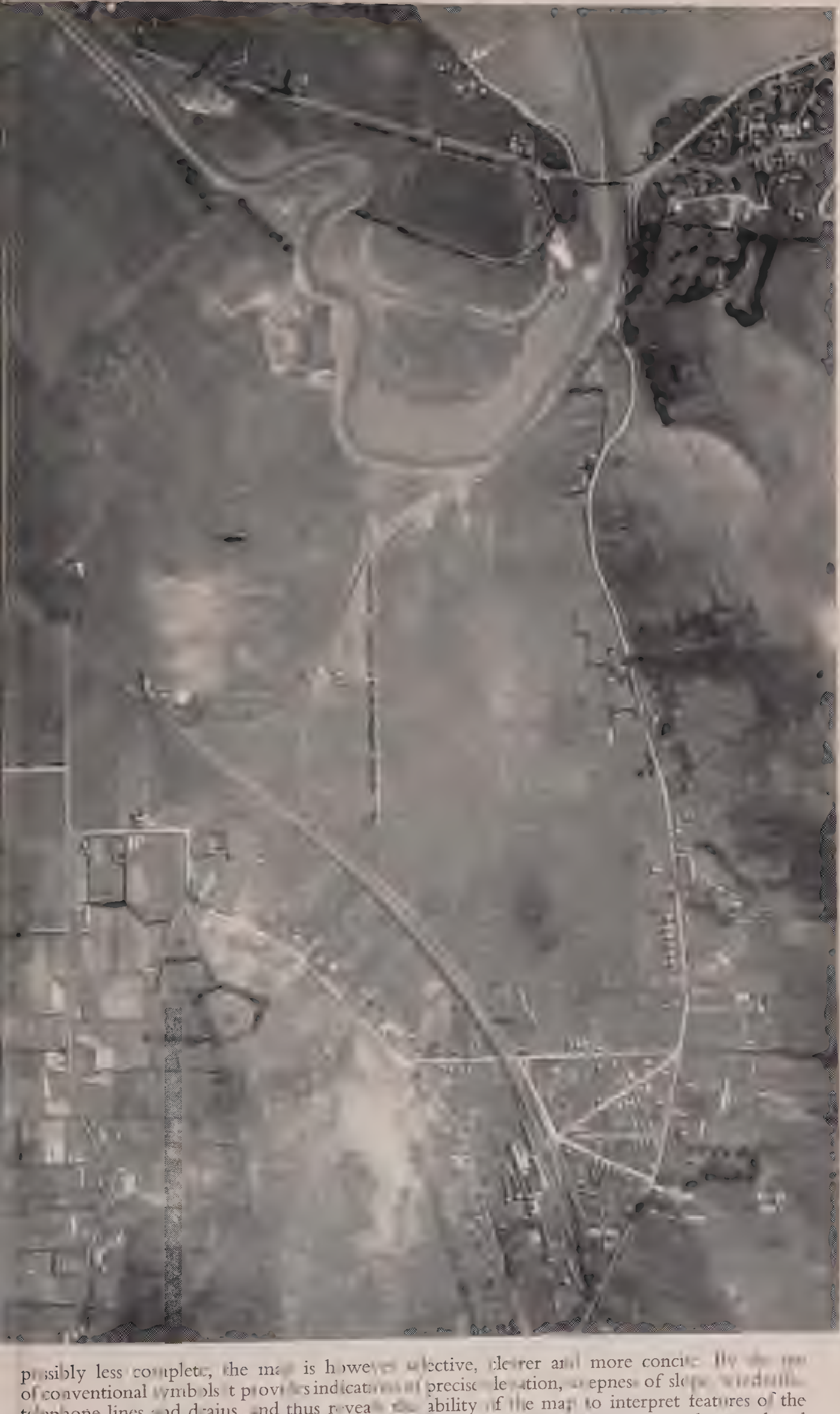
For this reason the mosaic map carries above it the statement: 'This mosaic is not an accurate map. Errors should not exceed five percent in flat country and ten percent in hill country'. Accuracy greater than this is required less often of a map than is generally supposed and the recognition that the inaccuracy may be there is sufficient warning. The mosaic is described as 'semicontrolled', implying that in its construction the overlapping photographs are tied in to surveyed stations. In individual photographs the mosaic may be printed to adjust a change of scale as the camera moves from lowland to highland, but not adjusted to allow for tilt of the camera at the instant of exposure. The overlapping photographs are cut and feather-edged so as to give as continuous a tone as possible from one to the next. Where the country is closely farmed they may easily be cut along field boundaries or roads so that the junction of one photograph with the next is inappreciable, but where they must be cut across a surface which shows in the photographs a continuous tone the junction is very difficult to hide. Careless matching of tone may also spoil a mosaic; one light coloured print spoils the mosaic of the Waimakariri River on sheet S75/4.

The fundamental feature of the vertical aerial photograph, the way in which it differs from and supplements the topographical map, is far more profound than the mere measurement of distance and area. To make the map the surveyor selects ground detail and the cartographer delineates this in map form; the camera records what it sees at the moment the shutter opens, no more and no less. The implications of this are far reaching.

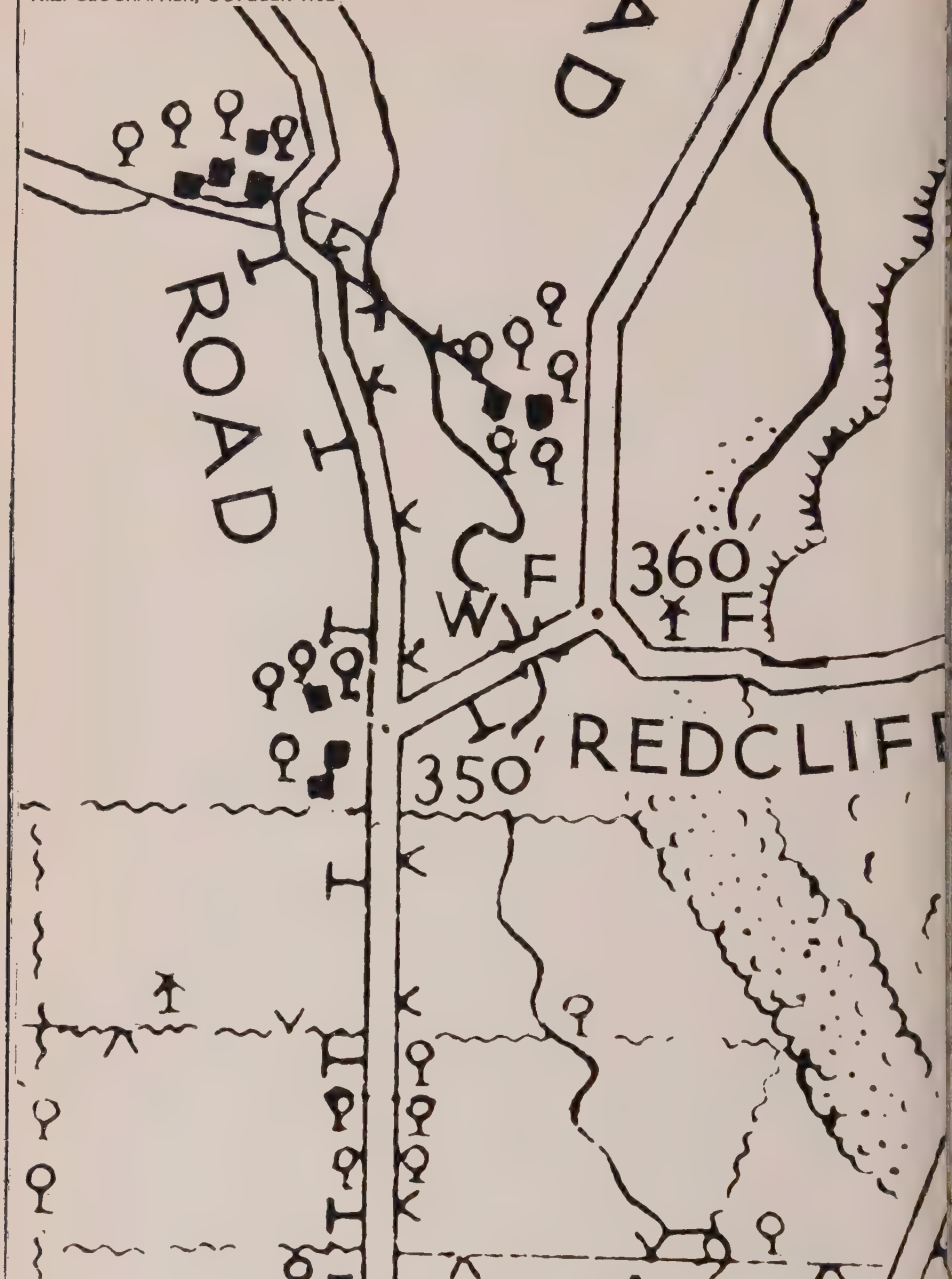
The map, particularly on a scale such as 1 : 63,360, necessarily omits a very great number of the features of the landscape. What it does show it must frequently generalise; its symbols for isolated groups of trees, for scrub, hedges, roads or farm buildings are conventional. Sometimes the symbol must be larger than the size of the object correct to scale; a road thirty feet wide would, if shown at its true scale, be less than 1/150th of an inch wide on a map on a scale of 1 : 63,360. It is therefore enlarged. This enlargement and generalisation is more serious on smaller scales; that it is much less for the 1 : 25,000 series than it is for the 1 : 63,360 series is to be seen by a comparison of vertical aerial photographs and topographic maps of the same area, with the maps enlarged to the same scale as the photograph. (See Figures 1, 2, 3 and 4.) This comparison is obviously unfair



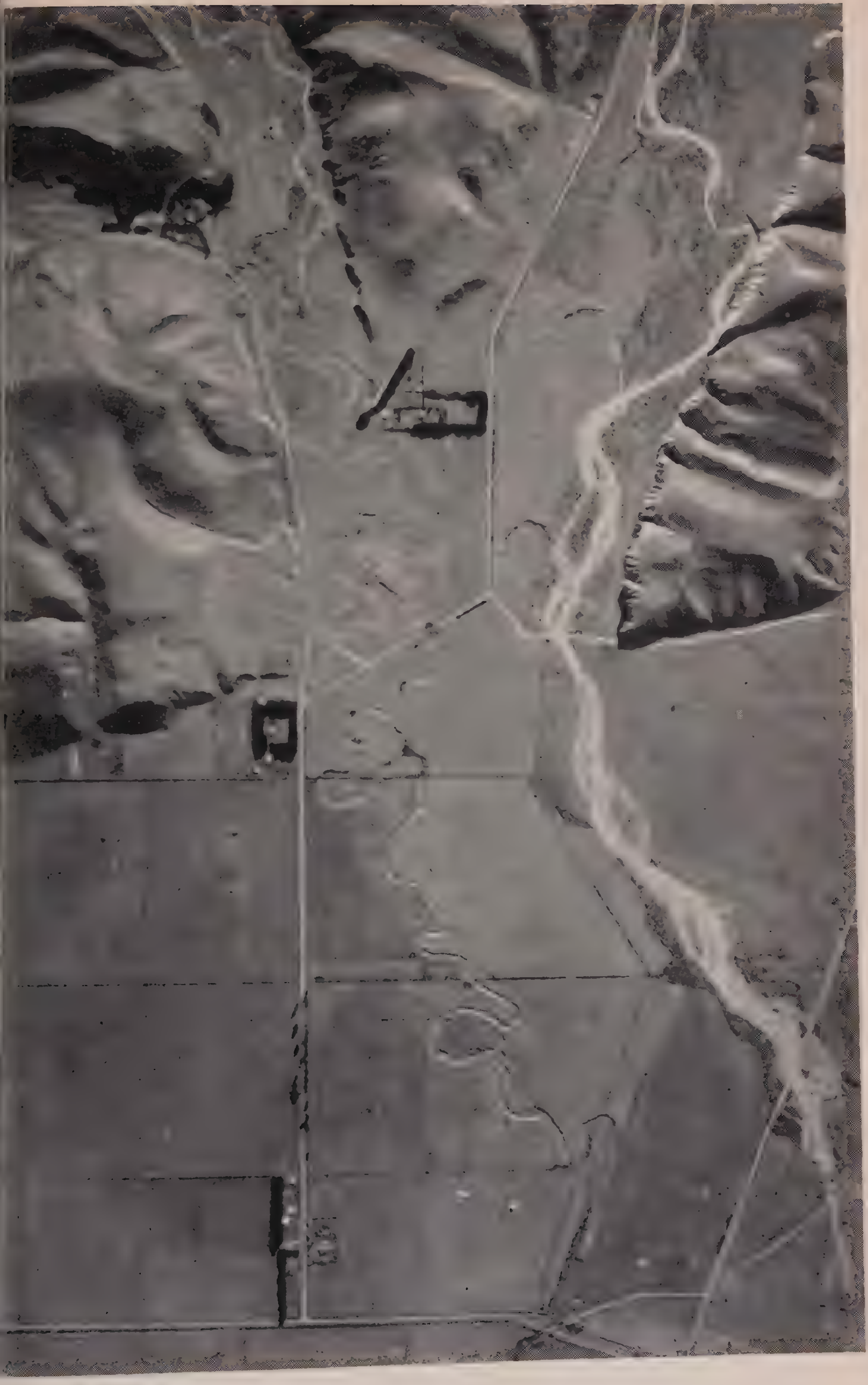
*Figs.* 1 and 2. On a scale of 1 : 25,000 the topographic map presents a more effective picture of the landscape than the photograph on the same scale. In this case the topographic map of a portion of the Heathcote Valley, near Christchurch (see N.Z.M.S. Series No. 2, Sheet S.84 2) has been enlarged to a scale of 1 : 15,840 to correspond with the scale of the photograph. A comparison of the map and the photograph demonstrates that, although



possibly less complete, the map is however selective, clearer and more concise. By the use of conventional symbols it provides indications of precise elevation, steepness of slope, windmills, telephone lines and drains, and thus reveals the ability of the map to interpret features of the landscape present but not clearly defined on the photograph. (Map and photograph reproduced by permission of the Department of Lands and Survey.)



*Figs.* 3 and 4. On a small scale a map must omit, simplify or exaggerate detail in order to show it at all. In the present case a portion of the Duntroon sheet near Ihawai on a scale of 1 : 63,360 (see N.Z.M.S. Series No. 1, Sheet S.127) has been enlarged four times to the scale of the accompanying photograph. Paucity of detail is very apparent as is also the



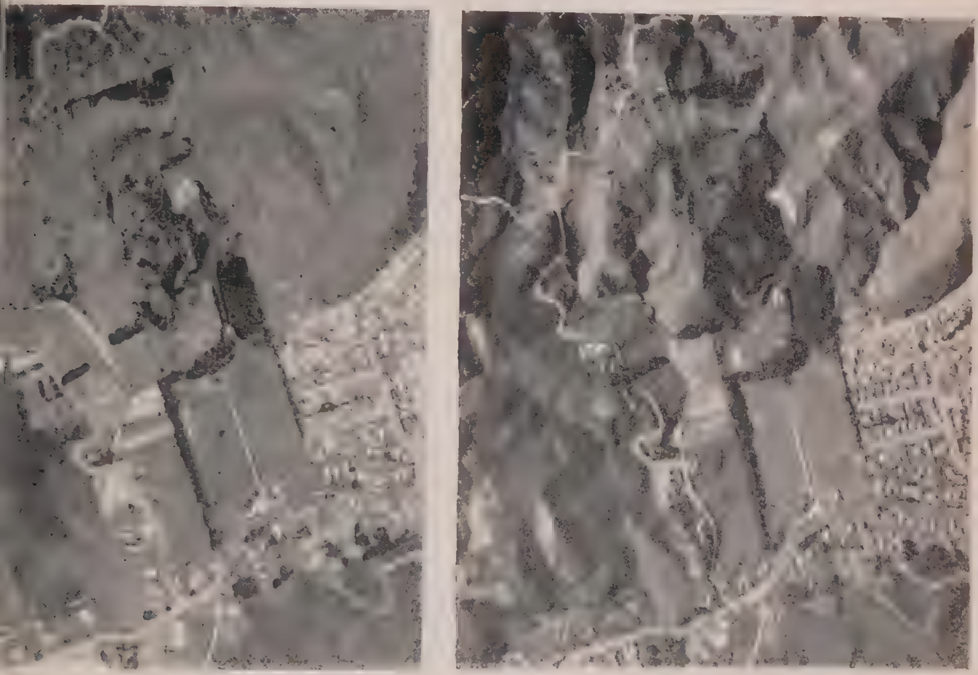
exaggeration in width of roads, and in size of buildings and of tree symbols. Notice too the simplification of the stream pattern. The photograph moreover shows certain detail in the pattern of land use and more precisely distinctive features of the vegetation and surface configuration. (Map and photograph reproduced by permission of the Department of Lands and Survey.)

to the map, which is not intended to be used like this. It does however emphasise the capacity of the aerial photograph to record, but not to select. The photograph may show details of the farming pattern, or the incidence of soil erosion, or the exact detailed features of second growth. The map may or may not record these according to the kind of map it is. The map may show, however, a number of things which are not clearly depicted as such on the photograph: telegraph lines, post offices and schools for example. In this way the map emphasises its capacity to select. The topographic map, moreover, shows by means of contours the actual height and the slope of the land, which cannot be shown by a mosaic.

When the aerial photograph is made into the mosaic the capacity to record what the country actually looks like from above is its most valuable feature. On the Galatea sheet (N86/5) the afforestation blocks can be seen in all their variety against the meandering Rangitaiki River; on the Tangimoana sheet (N148/2) every detail of the fixed sand-dune country can be studied in its contrasts with the closely-farmed alluvial terraces of the Rangitikei; in the Cust sheet (S75/3) the lines of stream movement on the plain can be followed in detail, although some of these lines are quite invisible on the ground. To some of the sheets exciting is the only word to apply: the gash of the Tarawera chasm across the Ruawahia sheet (N77/7), the Waimakariri on the Sheffield sheet (S75/4), the unique picture of the surface of an area blanketed by volcanic ash on the Mangaharakeke sheet (N86/2), or the superb incised meanders of the Tutaekuri on the Waiwhare sheet (N124/7).

The run of single aerial photographs has something which the mosaic can have only rarely—the capacity to show the land in stereoscopic relief. This, one of the most valuable features of the vertical aerial photograph, may be applied to make the mosaic stereoscopic in the process known as *vectography*, which uses the principle of polarised light. One mosaic is made up of alternate even-numbered photographs, and is printed on a medium which polarises the light in one direction. A similar mosaic is made up of the odd-numbered photographs, polarised at right angles to the first, and superimposed on it. Suitably adjusted polarising spectacles enable one eye to see one mosaic, and the other eye to see the alternate one, thus building up a stereoscopic picture of the area. This process, used during the last war, is not yet in general production and, in the absence of any method of using stereoscopic vision on the aerial photograph of which the mosaic is made, the user must fall back on the interpretation of the photograph as a record in shades of grey.

In the interpretation of mosaics the question of shadow is all-important. If there is no shadow recorded when the area is photographed, landforms and objects must be identified by the tone which they record on the negative unassisted by shadow. The presence or absence of shadow is of vital importance to the general impressions of relief which the mosaic gives. If the area is photographed at noon there will be little shadow to throw up the configuration of ridge and valley with a north-south direction. This however is strongly brought out by photography later in the day. To illustrate this Figure 5 shows the same area photographed under dissimilar shadow conditions; the difference in the impression of relief is striking.



*Figs.* 5 and 6. Karori Park, Wellington, photographed at noon (left) and in the afternoon (right) showing the different impression of relief given by shadows.

# GEOGRAPHY IN SCHOOLS . . . .

## 1. *PRIMARY-SCHOOL GEOGRAPHY*

*J. H. Martin*

GEOGRAPHY in the primary schools of New Zealand has been obscured by its inclusion in the current syllabus in social studies. To some observers it appears to have lost its distinctive identity in favour of a combined course that is neither history nor geography, but largely a collection of odd, ill-assorted themes and topics. Be that as it may, the teaching of geography in primary schools remains a field of pedagogic argument, much of it deriving from the new and changing concepts of the subject in recent years.

In 1928 a new syllabus in geography was introduced into the schools and remained in force officially until replaced by the present syllabus in 1946. In the 'twenties this former syllabus represented a considerable advance in the teaching of the subject in that stress was laid upon first-hand studies of the local area, upon the importance of a 'humanistic' approach, and upon informal methods of teaching. It made an immediate appeal to teachers by virtue of its supposedly logical development, with carefully-graded steps in the teaching of physical geography and the geography of countries, all leading to the final goal of demonstrating causal relationships between the natural environment and human affairs. In contrast with the present syllabus this was material not unfamiliar to teachers, and there were textbooks to fill any gaps in their knowledge.

Viewed in the light of the more recent concept of geography, however, the 1928 syllabus was basically unsound. It was completely deterministic in outlook. In the appendix to the official statement (on method) teachers were exhorted to 'stress the why of things continually'. Statements such as . . . 'in this way the pupils will be led to see that the industries and products of a place depend almost entirely upon the natural physical characteristics of a district and its climate' form the dominant theme of much of its text. It was also explicitly stated that the aim of the geography lesson was to establish geographical laws, to give practice in applying these laws when attacking new work, and to subordinate memory to reason. To conform to this philosophy, the suggested programme for each class was carefully designed so that studies in mathematical and physical geography led on to systematic studies in the geography of selected countries.

### GEOGRAPHY AND THE NEW EDUCATION

It was, however, the growth of a new outlook on educational theory and practice that really focused attention upon the need for recasting the syllabus. Educationists, if not geographers, were becoming more and more critical of the type of geography that was being taught in New Zealand schools, chiefly on the grounds that, to them, it seemed in large degree unrelated to the needs and interests of young children. In particular they were critical of the emphasis given to physical geography, for, in spite of the instructions given in the appendix to the syllabus, this almost invariably tended to be taught as isolated, formalised topics, and almost half the prescription for each class consisted of physical geography. This reaction to established ideas owes much to the work of the New Education Fellowship begun in 1937. Through the fellowship three important guiding principles were given new emphasis.

The first of these was that the mental processes of young children are very different from those of adults, so that the selection of material to be treated in any particular subject should be based upon the way children learn. In this respect the important thing to remember, they believed, is that children organise their knowledge best around the pursuit of topics, rather than through compartmentalised subjects. It was in accordance with this theory that the new syllabus was arranged in the form of a combination of topics in history and geography.

The second principle emphasised that the goal of education should be the development of responsible citizenship. When applied to the teaching of history and geography this meant that the fundamental purpose was to lead the child towards some understanding of society—local, national and international. Hence the emphasis given in the syllabus to what have been called 'attitudes, appreciations and skills necessary in a democracy'.

The third of these principles was one which has profoundly influenced the methods of teaching used in schools during recent years. Broadly stated, it is that knowledge can be meaningful to a child, and can contribute to his personal growth, only when it has been acquired by purposeful application on his part. In the words of the Hadow Report: 'The key to method and curriculum has been wisely said to be activity and experience, rather than knowledge to be acquired and facts to be stored.' Although this was no new doctrine, it was given new meaning by the work of the fellowship. Its significance in the syllabus is indicated by the attention given to project work and the need for widening the child's experience by means of class excursions to make first-hand observations in the local area.

## Recent Syllabus Revision

As the result of this new and broader outlook, a move was made towards the revision of the syllabus in both history and geography. This culminated in the setting up of a consultative committee in December 1944. The committee, in drawing up its report, obviously gave consideration to the educational principles outlined above. Considerable attention, too, was given to the philosophy and content of the new social studies prescriptions that had been adopted in other countries, especially in the United States. While recognising the importance of the sociological bias given in these, however, the committee was not unmindful of the intellectual and educational values of studying history and geography as distinct disciplines. Thus the draft syllabus which it submitted placed less emphasis upon sociology, and gave a more definite place to history and geography, than did any of the overseas syllabuses in social studies of that time.

When the committee's report was presented for consideration by teachers, it met with a very mixed reception. This was only to be expected when such a radical departure was made from the traditional approaches in which most teachers had been trained. As a result of the trenchant criticisms made by groups of senior teachers, the Department of Education undertook the modification of the proposed prescriptions, and issued a revised and official syllabus, *Social Studies in History and Geography for Primary Schools*. In general the main departures from the original draft were the omission of some topics (such as 'The Struggle for Freedom') and in the rearrangement of others to give a more equitable distribution of content material among the syllabuses of different forms. These changes have, in the opinion of some teachers, destroyed much of the unity of the draft syllabus presented by the committee, especially in the first and second forms. A more serious criticism is that, while the history of New Zealand figures prominently in the work for every class, the geography of New Zealand has been comparatively neglected, the only comprehensive treatment of it being in the third standard.

A still further criticism is that insufficient attention has been given to physical geography. Except in Form II, where 'The Physical Basis of the World' is a definite topic, the only reference to physical geography is in the form of appendages to the prescriptions for Standards 3 and 4 and Form I. In practice it appears to be very much neglected. Surely society cannot be understood without a sound knowledge of the natural environment in which it exists. Furthermore, young children are naturally interested in physical phenomena—in the sun and the moon, in the clouds and the weather, in volcanoes and mountains and streams. Here, then, is opportunity for really valuable observational and experimental work in which children would often be better employed than in studying the manifold processes of manufacturing industries.

Nevertheless the syllabus, properly interpreted and conscientiously followed, will allow much valuable work in geography to be done in primary schools. Although history and geography have been combined as units of study, there is a satisfactory balance between the two. If an intelligent selection of subject matter is made, therefore, there is ample opportunity to lay firm foundations for more advanced work in the higher classes to which most of the pupils will proceed. The chief merit, however, lies in the attempt that has been made in the new syllabus to relate the topics for the various classes to what appear to be the natural interests of the growing child. Unless the syllabus of instruction for any subject fulfils this requirement, it cannot be regarded as educationally sound. More could be said in criticism of the syllabus but it is more important here to review the approach to geography that has developed in its wake.

## Geography in Social Studies

Although six years have elapsed since the new syllabus was introduced, a surprisingly large number of teachers are still uncertain—some even hopelessly confused—about the meaning of social studies. This may be because, when the syllabus was issued to schools in its official form, the only specific reference to the term was in the title, while later attempts to clarify aims and purposes, and to demonstrate suitable procedures, have been far from adequate. Some teachers assume that to carry out the spirit of the syllabus they must by some means devise plans of work which will bring about a complete integration of history and geography to make it a social study. Others, more confident, but still obviously confused, even assert that there are now no such subjects as history and geography in the primary schools, but 'only social studies'. Some indeed are almost afraid to mention the names of history and geography in the classroom, or, if they do, are quite apologetic about it. But, while an academic treatment of geography is obviously too remote for young children, the syllabus includes many topics which involve the study of human activities in relation to place and are a prelude to regional geography. Why, therefore, should the children not appreciate that they are then studying geography?

Until a clearer concept of the nature and common purpose of history and geography in the social studies programme becomes general among teachers confusion will continue to inhibit sound work in the schools. Any forced attempt to merge the two disciplines into a complete subject-unity introduces such complexity that the general pattern cannot easily be distinguished. Perhaps the clearest definition of the term available to date is Miss A. M. Gorrie's: 'Social studies in New Zealand primary and post-primary schools is a covering term for a *new* kind of history and a *new* kind of geography, taught in a new way; it is an approach to two separate but complementary disciplines. There is integration of purpose rather than of subject matter, though some integration [of subject matter] is inevitable and inescapable.'[1] In teaching history the teacher is trying to provide understanding of what life was like at some particular time, and so reference must be made to geography if the picture is to be complete. In teaching geography the influence upon human occupance of such aspects of history as traditions, politics, international affairs, economics and religion is recognised. The Consultative Committee on Post-Primary Education also envisaged an integration of history and geography in terms of purpose, rather than in terms of subject matter, and stressed that the unifying theme was an understanding of man in society.

## Applying the New Syllabus

This seems the only practical and sensible way of approaching the task of drawing up a scheme of work in social studies. The syllabus is so arranged that most topics are predominantly history or predominantly geography, although some are apparently a combination of both. For instance, topics such as 'Transport and Communications' require both historical and geographical treatment. Whether the method is to commence with the geography and then lead back to the history, or the reverse, is for the moment immaterial. What is important is that even here a complete merger of history and geography need not be attempted; instead they should be treated separately in relation to the same topic. If teachers realised this more fully, their work would be simplified, their approach more positive, and the final goal, that of understanding society as it exists at home and abroad, more easily attained.

Another cause of the hesitant way in which some teachers approach their work can be found in the wide scope of the syllabus. Although it is generally understood that the prescriptions for the various classes are only suggestive, and that teachers are required to make a selection of topics from the various sections, they find the task bewildering and difficult to do satisfactorily. Many feel that they have not the necessary background of experience and knowledge to make the best selection or to extend the work in some of the topics given bare mention in the syllabus. They plead for more direct guidance—a more precise statement of what they should do. Teachers in intermediate schools and post-primary schools likewise call for a plain statement of minimum requirements for each class. At present, they say, pupils from a number of different contributing schools come to them with a widely diffused knowledge about all manner of things, but with little in the way of a common core of knowledge upon which to base new work.

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[1] A. M. Gorrie: *Social Studies in New Zealand,* Book 1, Auckland, [n.d.], p. 7.

But is the definition of a compulsory core for each class practical or desirable? Would not the minimum requirements for each class tend to become the maximum coverage in many cases? Would not the fact that the pupil's knowledge of the common core would be readily examinable by headmasters and inspectors tend to make the work too restrictive, with reversion to older methods of cramming and rote memorisation?

Reference should also be made to another outstanding feature of geography teaching in recent years—the widespread use of 'activity methods'. Almost every class is divided into groups for the purpose of carrying out projects and assignments. Because of the wide variation in the abilities of teachers to apply such methods, the results vary from the really excellent at one end of the scale to the positively alarming at the other. Where the work is being skilfully directed by a teacher who has a clear understanding of the ultimate end to be achieved, the educational value of the method is unquestionable. It stimulates pupils to make their maximum effort; allows them scope to develop their individual talents; lends purpose to the work in other subjects; instils habits of research; and above all fosters an interest in geography because they are finding out things they themselves really want to know.

Yet much purposeless work is also being done. This is usually because more is being attempted than the capacities of the children, or the time and equipment, will allow. Thus frustration and loss of interest are inevitable. In many cases, too, the pupils range widely without mastery of anything. Lacking proper guidance, they collect so much information that they are unable to select the essentials and assimilate them. Whereas the able teacher carefully draws the threads together in formal lessons so that all the pupils can see the whole pattern and come to worthwhile conclusions—even if tentative—his less able colleague allows them to diverge so widely that they are lost in a haze of uncertainty.

## Reality in Geography Teaching

One final matter deserves mention. Many teachers of geography still follow the traditional systematic method in their work. Yet this approach lacks reality for primary school children, who are still at the stage of collecting and sorting their information, and have but a limited capacity for logical reasoning or generalisation. While teachers should probably work with the regional idea in mind, the approach at this level should be 'through detailed descriptive studies of more limited topics'. For instance, the study of life in monsoon lands with a Standard 3 class could be centred round a graphic description of the life of a family in an agricultural village in south China. Stories and pictures could be used to introduce the wealth of illuminating detail which alone will stimulate accurate and vivid imagination. Such an approach makes a natural appeal to young children, gives scope for a simple demonstration of man-to-nature relationships without undue emphasis upon environmentalism, and, above all, avoids the learning of generalities and the lack of detail which as James Fairgrieve says 'tends to that unreality which is the deadly sin of geography teaching'. Arising out of the work there will almost certainly be many questions which the children want answered so that there will be ample opportunity for practice in simple reasoning, while subsequent activities, such as additional reading, sketching, modelling, recording and the like, will serve to establish the facts or ideas which are worth retaining in the memory. But they will be facts or ideas that have reality for the child, rather than meaningless labels, or knowledge learned parrot-fashion, as is often the case when traditional systematic methods are followed.

Herein lies the real secret of successful teaching of geography in primary schools. Where the pupils are introduced to the subject through the medium of simple little studies of real life in their home district, in other parts of New Zealand, and in the wider world beyond, their interest will be aroused, and interest leads to a search for understanding and to sustained effort. The new syllabus gives ample scope for such work, while the wealth of interesting literature that is now becoming available in the schools should help teachers to apply the method in practice.

## 2. *SIXTH-FORM GEOGRAPHY*

*J. L. Hewland*

THE following observations on sixth-form work in general, and geography in particular, derive from recent experience both in New Zealand and at a County Grammar School in England. This experience has made it clear above all that sixth form work in England reaches a higher standard than in New Zealand. How is this? What can be done in New Zealand to raise our standards? The answers to these questions and the suggestions put forward here refer particularly to geography: it would appear, however, that they may equally well apply to some other subjects.

### THE SCHOOL CERTIFICATE CANDIDATE

First it is necessary to know something of the background of the respective sixth-form pupils. There appears in fact to be very little difference between the two countries in this respect. Both in the United Kingdom and in New Zealand the years preceding the sixth form are generally occupied with regional studies which cover the world; the school certificate examination is taken at about the same age (a candidate in England must be sixteen years old before he can receive his certificate) and requires approximately the same general standard of work.[1] To understand fully the programme of work in geography before the sixth form, however, it is helpful to compare examination prescriptions of the two countries. Amongst several examining authorities is the University of Oxford and under its auspices the school certificate examination in geography consists of two ninety-minute papers: the first is a general paper with questions ranging from detailed enquiries about ordnance survey maps to others on general (or systematic) world geography—physical and cultural; the second paper contains questions on the regional geography of the British Isles and *one* continent. In New Zealand, the school certificate prescription has a similar and perfectly sound aim of ensuring that candidates have studied all parts of the world to some extent, but the practice of making the whole world examinable (in the one examination) has been criticised before[2] and there is evidence that its dangers and difficulties have become more widely appreciated during the last five years.[3] Whereas the English pupil moves on to sixth-form work with a detailed knowledge and a deeper understanding of his home country and one continent (usually, of course, Europe), the New Zealand pupil can be expected to have a wider and more superficial knowledge of the world but correspondingly less understanding of the aims, objects and special requirements of his subject.

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[1] In so far, that is, as uniformity of standards can be judged in England and Wales where there are at least eight different examining bodies.

## EXAMINATIONS

In England the school certificate is a prerequisite for entrance to the university, whereas in New Zealand the university entrance examination comes a year later.[4] Nearly all pupils of a county grammar school, therefore, who return to the sixth form, do so with the intention of staying for at least two years, in order to win a university scholarship. A two-year course is planned undisturbed by worries about an external examination halfway through it. In New Zealand, the university entrance and entrance scholarship prescriptions in geography are so wide and overlap so much, however, that in his *first* sixth-form year, the candidate is forced to cover again the geography of practically the whole world and to acquire an elementary knowledge of several specialised sciences in order to qualify as a candidate for the entrance examination. He must then repeat much of this work in his *second* sixth-form year in order to cover what is again far too wide a syllabus for the entrance scholarship examination. At this later stage his syllabus of work is not vastly different from that of his English counterpart, who, however, has less ground to cover in twice the time. The English sixth-form pupil can therefore really study the regions set him, take time to think and talk about them and to discuss their problems instead of hurrying on incessantly to 'do' the syllabus. A sixth form in England taking the Oxford examinations probably spends a year on the British Isles and northwestern Europe and the second year on Africa (one a developed and one an undeveloped area); but the New Zealander does not normally divide his regional work between the two years as he must cover so much of it before the entrance examination.[5] Examination prescriptions have been emphasised here because in sixth-form work they determine the quantity, and therefore to a large extent, the quality, of the work done. It would seem possible that what is the New Zealand pupil's greatest burden could be overcome if the university entrance and university scholarship prescriptions were made complementary (instead of overlapping) not only with each other but also with that for the school certificate examination, with each narrower in scope than at present yet requiring a higher standard of attainment. Alternatively accrediting for university entrance could be made only after two years' work beyond school certificate, thereby raising the standards required for admission to the university.

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[2] See J. L. Hewland: 'Geography and Social Studies', *N.Z. Geographer,* Vol. 3, No. 1, April 1947, pp. 83-89.

[3] In New Zealand the requirements for school certificate could very well include an examination in the regional geography of no more than New Zealand, the British Isles and Europe, involving a knowledge of the use of pictures and topographic maps as a means of studying the characteristic features of the regions concerned, together with some knowledge of the geographic background of current world events. The three regions mentioned are recommended because of their historical, cultural and commercial connections and because a study of them fits well with the work in other school subjects, and is suitable to the pupil's particular stage of development. They are not recommended because they are 'typical' or 'important' regions and so no question of individual assessments of what is 'typical' or 'important' arises.

[4] This does not imply, of course, that the university will accept matriculation on the basis of the school certificate as the only qualification for entrance.

In English sixth forms there is also greater specialisation. The usual course is based on three subjects, either arts or sciences. This may be related to the much greater specialisation within the university itself, where so often only one main subject is required to be taken for a bachelor's degree. New Zealand's system is probably better suited to local conditions. England has nothing like our country district high schools where a teacher may be required to teach three or even more subjects. For a variety of reasons, the much greater specialisation in the English university is reflected in a greater specialisation in the sixth form of schools where a pupil is usually intent upon winning a scholarship awarded in one subject, or in two or three allied subjects. He does not have to compete for these scholarships with pupils working in other subjects; no pupil on the arts side is likely to have to compete with one on the science side. There is no such thing as 'scaling' of marks or assessing the relative value of entirely different subjects in terms of possible marks, or of making a pupil study five subjects for a scholarship. In New Zealand scholarships could similarly be awarded to greater advantage in a subject or group of allied subjects —in mathematics, in natural sciences, in modern languages, in classics or in the social sciences (where there are suitable candidates in each case), thus obviating any question of unfair competition outside the particular group of subjects in which the candidate presents himself.

## STAFFING

Still another difference reflects the greater specialisation in English universities. The teaching staff of English grammar schools is even more specialised both by qualification and in its work than in city high schools in New Zealand. Mathematics masters do not usually teach science as well; history masters seldom teach geography; the French master may teach Spanish or German or Russian but leaves Latin to the classics man. Whether this is good or bad is beside the point; but it does ensure that the sixth former is usually taught by one who is fully trained in, and master of, his subject. Such is sometimes the case in New Zealand, but here the number of such specialised teachers is fewer because the sixth-form pupil-staff ratio is so much higher. If a New Zealand secondary school were to be staffed as in England, its present staff would have to be increased by approximately twenty-five percent. This, of course, would mean, especially, more and much smaller sixth forms. Some English sixth forms already have fewer than ten pupils and are in charge of highly-trained and skilled specialists who are thus able to give time to individual pupils who themselves do not have to contend with an absurdly wide examination prescription.

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[5] The university entrance prescription includes the regional geography of the British Empire, Europe, the South Pacific and the rest of either Asia and Africa or North and South America, as well as an elementary knowledge of geomorphology, climatology, meteorology, oceanography, cartography, and mathematical geography. These 'ologies and 'ographies add up to approximately the same as the English pupil's 'physical geography'. The New Zealand pupil has also to work in somewhere a study of what the prescription calls 'world patterns' and defines as the 'distribution of natural and cultural vegetation, soils, livestock, and minerals, and the world's power-resources, and industry and trade'. The entrance scholarship prescription requires a study of the British Isles again, and of two of the following: the South Pacific, Europe, and North America, in addition of course to systematic physical geography, referred to in the prescription in fanciful, ambiguous and outmoded terms.

By extending the number of secondary school bursaries awarded each year and by increasing staff for sixth-form teaching this situation could be attained also in New Zealand, although it must be appreciated that no sixth-form work can be satisfactorily carried out, of course, without adequate library facilities and good textbooks. In England, where all books are loaned to the pupils, each subject receives an allowance for the necessary texts. This means that the teacher in charge of the subject can use some of the grant to buy several different textbooks for his sixth-form geography and so keep the geography library up-to-date. This is especially valuable in a subject in which there seems to be no text written at a standard between that of the school certificate examination and that of first year work in the university. Books used in early university courses are too expensive to ask New Zealand pupils to buy, especially over so wide a syllabus.

In other matters there would seem to be less difference between English and New Zealand sixth forms. The work of the English sixth-form pupil is interrupted just as much by cricket and football matches and monitorial duties, although rather than keep fit to play rugby, he plays rugby to keep fit. He, too, often takes a job in the holidays but he seems to accept holiday reading tasks more readily than his New Zealand counterpart. Although he has a greater range of daily and weekly newspapers to read, and infinitely better broadcasts on current affairs to listen to, he seems less well-informed on world affairs than the New Zealand boy; or perhaps it is that he is less interested. On the other hand there is in the English school a feeling of greater freedom to discuss topical problems than there is in the smaller New Zealand community. Such general observations are of course based only on limited experience of an exchange teacher tied to one school during his stay in England; but they are the result also of discussion with colleagues in that school and in others, and with university and training college teachers. The extraordinary variety that exists among 146 local education authorities and a long list of public schools makes any generalisations very suspect.

It would appear, however, that if New Zealand educational authorities wish to raise the standard of work in sixth forms, they can learn much from the best of English practice. Accepted English practice suggests a narrower field of study in both the number of subjects and the content of each subject; the devotion of time to a deeper and wider study of the field to be covered; a revision of the examination prescriptions so as to make possible a two-year course to university scholarship which will automatically provide the qualification for university entrance at the end of the first year or at the end of the second year if the university decides to raise the standard of admission; provision for staffing sixth forms more adequately and for giving every child in the dominion an opportunity to work with others at an equal standard; a more equitable system of awarding university entrance scholarships, thus increasing incentives; and the means to build and maintain a good subject library of up-to-date texts.

## The Teacher's Part

To submit the above list of suggestions to educational authorities without any reference to the teacher's work in the classroom, would be to offer a cart and no horse to pull it. As it is, the willing horse is being asked to pull an overloaded cart at an excessive speed. Let us suppose that the sixth-form teacher had to cover a reasonable syllabus which gave him more freedom to develop the pupils' studies in his subject as he would like. Sixth-form geography involves at least two processes; first, discovering knowledge—that is, doing research, including fieldwork, by scientific methods; and second, mastering that knowledge and obtaining the necessary skill to use it. In geography the latter process begins by acquiring the art of describing clearly, either by written word, verbal description, maps, or a combination of these, what a piece of the earth's surface looks like. Before the sixth-form stage, the main process has been the acquisition of knowledge by simple learning processes without the complications of interpretation and explanation. In the sixth form work is designed to enlarge this knowledge and to develop a greater depth of knowledge of any region studied, thus enabling the pupil to go beyond the simple description and to draw for himself some conclusions. These may seem to the teacher to be false conclusions; but that is where the teacher finds his place in sixth-form work—in guiding the search for knowledge and information, and in influencing the conclusions drawn.

The information-getting—the research work—is the easiest part and should therefore be left largely to the pupils under the teacher's guidance. The child should of course go to primary sources wherever possible, especially in studies of his own region and home country, and from these primary sources he should draw some conclusions. If it is a region outside his home country, for which primary sources are less likely to be available, he may have to rely on conclusions drawn from statements in textbooks. His training, however, is incomplete if he relies on conclusions ready-made for him about his own region or country in a bulletin or textbook; and also if he has to rely on ready-made conclusions from insufficient facts as is the case when he is restricted to one cheap text. This emphasises the importance of keeping up-to-date the specialised library. If the library is not available, the teacher may become little more than a lecturer whose time is spent presenting the facts that the pupil should be getting from the library.

When he has gathered together his facts as far as time and available material permit, he must learn how to express his findings. There are three most common ways of expressing the findings of sixth-form research: the written essay, the seminar, and the debate, each supplemented by maps and other forms of illustration. Each is valuable and each demands not only careful assembly of facts but also an ability to recognise their relative geographic significance, to piece them together, and to draw worthwhile conclusions. In the case of the written or spoken result of his findings, the ultimate conclusions are to the boy the most difficult part. He finds it difficult enough to get the mass of facts to add up to a vivid picture of the region such as he would see if he were to travel through it. Here of course is a place for the visual aid, but there is no need to dwell on that now except to mention that one of the techniques he should learn even more thoroughly than in earlier years is to observe from photographs as he has learnt to observe in his local landscape. To draw relevant and valuable conclusions is the final and most difficult task of all; but the pupil should endeavour nevertheless to bring all written or spoken essays to a close with some worthwhile summary of the salient facts.

The third method of expressing findings, the debate, seems to offer a good practical method of teaching boys and girls to draw conclusions from a mass of facts. The pupil has the chance to be biased; when his home region is under discussion, he is almost bound to be biased, if he is really interested in his subject, and the fact that he may have strong feelings about causes helps him to speak more freely and to criticise the conclusions that his opponents draw. If he draws conclusions without sufficient evidence or by depending upon his emotions rather than his reasoning and observation, he must expect his classmates to pull his whole collection of facts to pieces.

The teacher's place in sixth-form work is to give the pupil a deeper and wider body of knowledge than he was able to absorb in his earlier years; to teach him to acquire this knowledge for himself; to try to open his mind to the tremendous field of knowledge yet to be tapped instead of closing it by supplying complete answers to his whys and wherefores; to train him to go to primary sources for information wherever possible; to teach him to draw some sort of conclusion from the knowledge he obtains; and to teach him to express his findings in clear, straightforward English.

# AIR TRANSPORT IN NEW ZEALAND

F. H. BISHOP

AIR TRANSPORT is the most spectacular feature of New Zealand's transport system today, whether internal or external. Nevertheless, it must be admitted that air transport still occupies only a minor position among the present methods of transport employed in this country. There are, however, local exceptions. In external transport, on the other hand, aviation's share in passenger transport is very important.

During its comparatively short period of continuous existence since 1935, air transport in New Zealand has, in spite of a serious setback during the war, made very great and rapid progress. Since 1945 both scheduled and non-scheduled air transport, and also aerial-work operations, have come to be so fully accepted by the people of the dominion that this country now occupies a leading position among the nations of the world for the importance of aviation in proportion to population. New Zealand is second only to Australia in the number of passenger flights per thousand of population and on the same basis ranks fourth in the world for passenger air miles. During the year 1950-1951 an average of one in every eight travellers in the dominion travelled by air. In Australia the comparative figure was one in five, in the United States one in nine, and in the United Kingdom one in a hundred.

## External Air Transport

Although in terms of both passengers and airmail external air services already hold a rank of major importance, air freight on these services remains as yet relatively unimportant. During the year 1950-1951, Tasman Empire Airways Ltd., the main operator out of New Zealand, carried only 220 tons of freight on all its services. However, TEAL carried almost the same tonnage of mail! It is in passenger traffic that the activities of external airlines are most significant. Of the 100,000 passengers who entered or left this country during the year, over forty percent travelled by air, mainly to or from Australia. During the last four years the proportion of external passenger traffic carried by air has ranged between thirty-five and fifty percent.

During March 1951, TEAL ran every week five return flights between Auckland and Sydney, four between Wellington and Sydney, and one return flight between Auckland and Suva. (Since then the Christchurch-Melbourne air service has started to operate, using landplanes.) The New Zealand National Airways Corporation also ran external services, return flights being made weekly between Auckland and Norfolk Island and fortnightly between Auckland and Rarotonga via Fiji, Tonga and Samoa. This last service has since been taken over by TEAL—as the Coral Route—and extended to Tahiti. Two overseas companies operated services to New Zealand during 1950-1951: British Commonwealth Pacific Airlines ran one return flight weekly between Vancouver and Auckland, and Pan American World Airways two return flights weekly between Auckland and San Francisco. A third and recent competitor on this Pacific route is Canadian Pacific Airlines. An allied air service (though hardly 'overseas' in character) was inaugurated late in 1950. This is the return flight once every six weeks during the summer made by a TEAL flying boat between Wellington and the Chatham Islands.

## Internal Air Transport

Air transport within New Zealand may be treated under three heads: the activities of NAC; the rail-air freight service across Cook Strait; and, finally, the miscellaneous activities of aero clubs, commercial aviation companies, and aerial-work operators. All these function in varying degrees in different parts of the dominion, and this variation contributes to regional differences in the pattern of air transport throughout the country.

NAC has a monopoly of internal scheduled passenger and mail transport by air, and also of scheduled air-freight transport with the exception of the rail-air service which is limited to freight and is operated on behalf of the New Zealand Government Railways. The NAC's charter required it to establish and maintain 'full and adequate services' for the dominion as a whole. The corporation set out to fulfil this requirement, and there are only three towns with populations of over 10,000 which do not have adjacent airports: Wanganui, Timaru, and Masterton. Thus the route pattern is now fairly comprehensive. A 'main trunk' route connects Auckland with Dunedin via Wellington and Christchurch. Northland has a service linking Whangarei, Kaikohe and Kaitaia. The rest of the North Island has routes around both coasts from Auckland to Wellington via Palmerston North, and there is also a central route through Hamilton to Palmerston North with a branch route to Rotorua. Cook Strait, between the two main islands, is bridged by frequent air connections between Wellington in the North Island, and Nelson, Blenheim and Christchurch in the South Island. From Nelson an air route continues along the west coast to far South Westland. Finally, a feeder service of some importance connects Invercargill with Dunedin.

### Passenger Traffic

NAC concentrates on passenger transport in its efforts to make its services pay. During 1950-1951 seventy-seven percent of the corporation's revenue came from passengers, while freight represented only 7.3 percent and mail only 3.6 percent; the other principal item was charter which accounted for 9.4 percent of revenue. On all NAC services, except the Westland route, planes fly on the average with considerably below-capacity loads in their freight compartments; this is particularly noticeable on most return flights from minor towns and cities.

The two most important sections of NAC's route pattern are the main trunk route and the Cook Strait link. The main trunk comprises only about twenty-six percent of the corporation's route miles, but its great importance is shown by the fact that during the year 1950-1951 it carried forty-five percent of all NAC's passengers on one or more of its sectors and actually accounted for over sixty percent of the total revenue passenger-miles for the year. It also carries an even higher percentage of the mail and freight.

The Cook Strait link overlaps with the main trunk route. It is of great importance, and during 1950-1951 128,000 NAC passengers crossed Cook Strait, that is, fifty-three percent of all passengers for the year. Of this total 32,000 passengers flew between Wellington and Nelson, 22,000 between Wellington and Blenheim, and 62,000 between Wellington and Christchurch, while 12,000 flew direct between Auckland and Christchurch. It is not surprising that shipping interests, notably the company operating the Wellington-Nelson service, are perturbed.

Cook Strait air-freight statistics are even more significant. On the NAC services, the Cook Strait sectors' share of total freight carried is even greater than for passengers. Some three-quarters of all NAC air freight during the year 1950-1951 made the interisland crossing. Moreover, during the same year the rail-air service transported an additional 14,000 tons of freight across the strait—almost ten times as much as NAC. This rail-air service is organised to link the railway networks of the two islands. The scheme is apparently unique in the world and has great possibilities for the future.

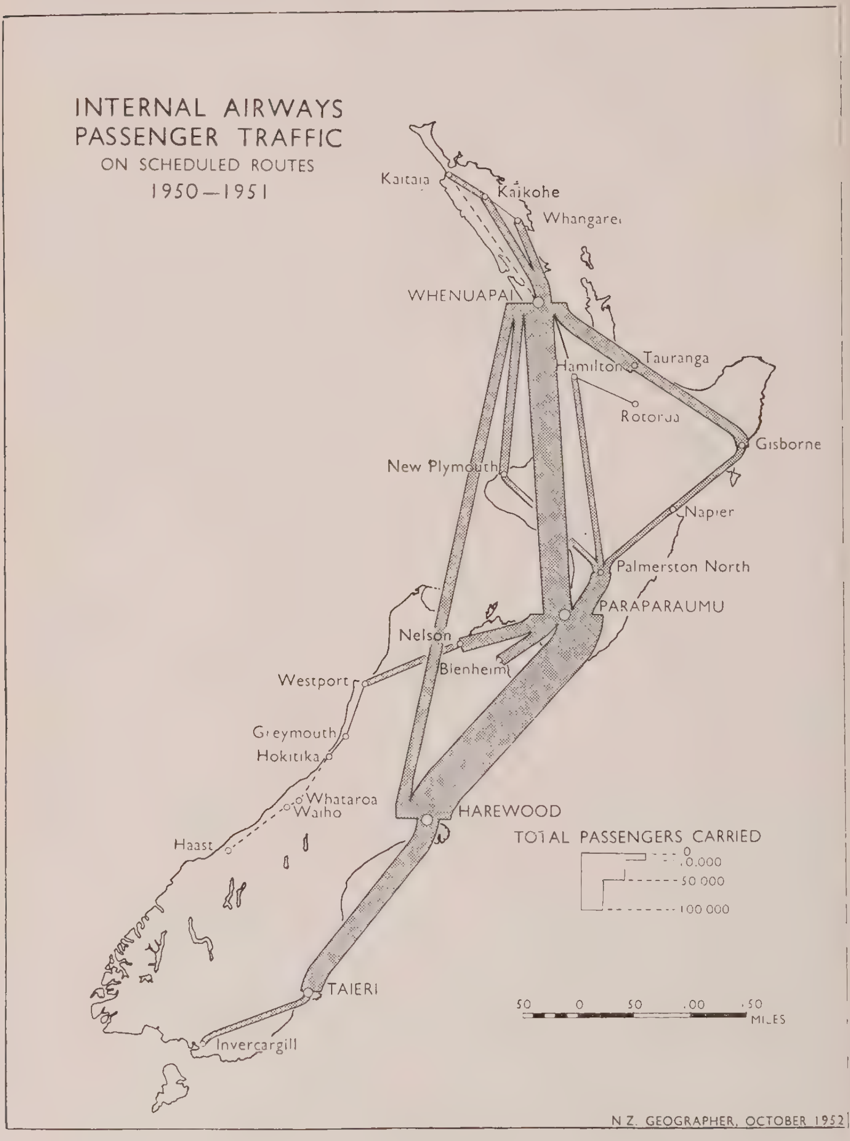

*Fig.* 1. Density of passenger traffic on scheduled internal air routes, 1950-1951.

Northland has the characteristic of remoteness; this is especially true of Kaikohe and Kaitaia. This remoteness is more the result of length of travelling time by surface means than of actual distance. In any case, the airmindedness of the population increases in proportion to distance from main centres. Kaitaia and Kaikohe are the most airminded towns in New Zealand if the number of air passengers in proportion to the local town population is any criterion.[1] On the other hand, freight and mail are carried by air to Northland in only small amounts, the freight traffic being mainly inwards. A notable characteristic of air transport in this northern part of the dominion is that for each town some three-quarters of all air passenger traffic travels only to or from Auckland.

The remainder of the North Island subsidiary routes are all (with the exception of the Rotorua branch) 'through' routes in contrast with what are largely 'terminal' routes in Northland, Westland, and Southland. Consequently, prospective air passengers have alternative routes available to them. The air services in this region are essentially for passengers; freight and mail are of minor consideration.

The Westland air route has several very distinctive features. This was the first commercial air route to be established permanently in the dominion, but it has still by far the smallest passenger traffic in the country, especially south of Westport. The route south of Hokitika is that on which the smallest planes in the country are used—Fox Moths. DC3's which are now the standard aircraft on most of NAC's services, fly as far south as Hokitika, and Greymouth is by-passed altogether.

The most interesting features of air transport in Westland are found between Hokitika and Haast. Here only three return trips a week are flown. Freight and mail transport here assume much greater prominence than they do anywhere else in New Zealand. Haast lies some thirty miles beyond the end of the road in South Westland and its only surface connection with civilisation is a rough bush track. Air transport is the life of the region. Supplies of almost every sort go into the district by plane and quite a variety of goods figure in the list of return freight cargo. All mail is taken to Haast by air from Hokitika without surcharge.

The Dunedin to Invercargill route has to be singled out for special treatment simply because it is left over after all the other obvious routes in the South Island have been dealt with. The route is flown by small Dominic aircraft which make the service a financial liability. It has also to operate in serious competition with rather good railway communications. In spite of these disadvantages it manages to carry eight thousand passengers a year, but the amount of freight and mail is small. It would be interesting to see the effect of the use of larger planes on this route, but before this can be done the Invercargill airport needs improvement.

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[1] South Westland is actually more airminded but had a population in 1951 of only 103.

## Non-scheduled Air Transport

The commercial activities of aero clubs, aviation companies, and aerial-work operators are much less important in total than the operations of NAC. Aero clubs generally enter very little into competition with the corporation, although across Cook Strait, mainly between Blenheim and Wellington, the local aero clubs fly the most important air-taxi service in the country, carrying thousands of passengers a year. The development of this air-taxi service occurred after NAC had to shift its Wellington airport site to Paraparaumu which is over thirty miles from the city. Small aircraft may still use Rongotai which is almost in the heart of Wellington. The Auckland Aero Club also does air-taxi work, the main traffic being with Great Barrier Island. The Marlborough Aero Club performs a most valuable service by transporting supplies inland to remote sheep stations which were formerly dependent on the slow, infrequent, and often more costly horse or mule transport. Southern Scenic Airtrips, operating out of Queenstown, is also prominent in similar activities.

Tourists are catered for partly by commercial aviation companies, chiefly at Rotorua, Queenstown, and Invercargill. Two companies have begun small scheduled passenger services from or to remote districts. One company links Nelson with Takaka, while the other runs a weekend service between Queenstown and Dunedin.

It is, however, the mushroom growth of aerial topdressing that has most caught the imagination of the New Zealand public. During 1950-1951 the number of companies active in this work increased from eight to twenty-two and the area topdressed from 48,000 to 428,000 acres. Most of this work is being done in the North Island where vast areas of hill country seriously need this fillip to fertility. Aerial-work operators have also been engaged in such other activities as aerial spraying, rabbit poison-bait spreading, trace-element distribution, aerial seed-sowing, and supply dropping.

# PHOTOGEOGRAPHY

## A PICTORIAL SURVEY OF NEW ZEALAND

## 9. AIRWAYS: INTERNAL AND EXTERNAL

Fig. 1. *In New Zealand today air transport, internal and external, meets an essential need. Here a PAA Stratocruiser has arrived at Whenuapai, the airport of Auckland, from San Francisco. But for passengers and mails the journey is not yet done; a coach will carry them the remaining fifteen miles to the city.*

*Photo:* Whites Aviation

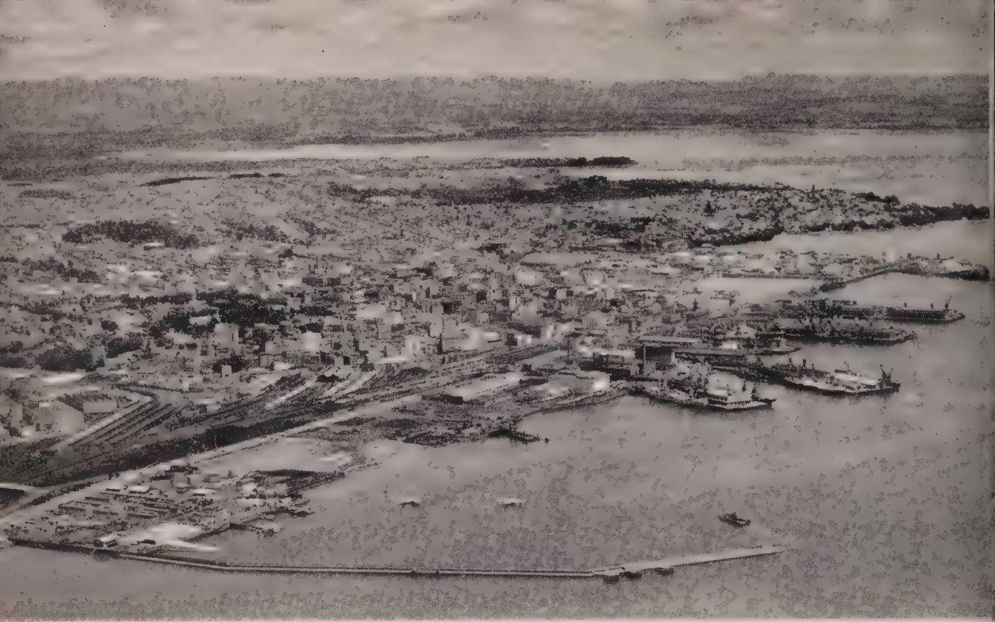
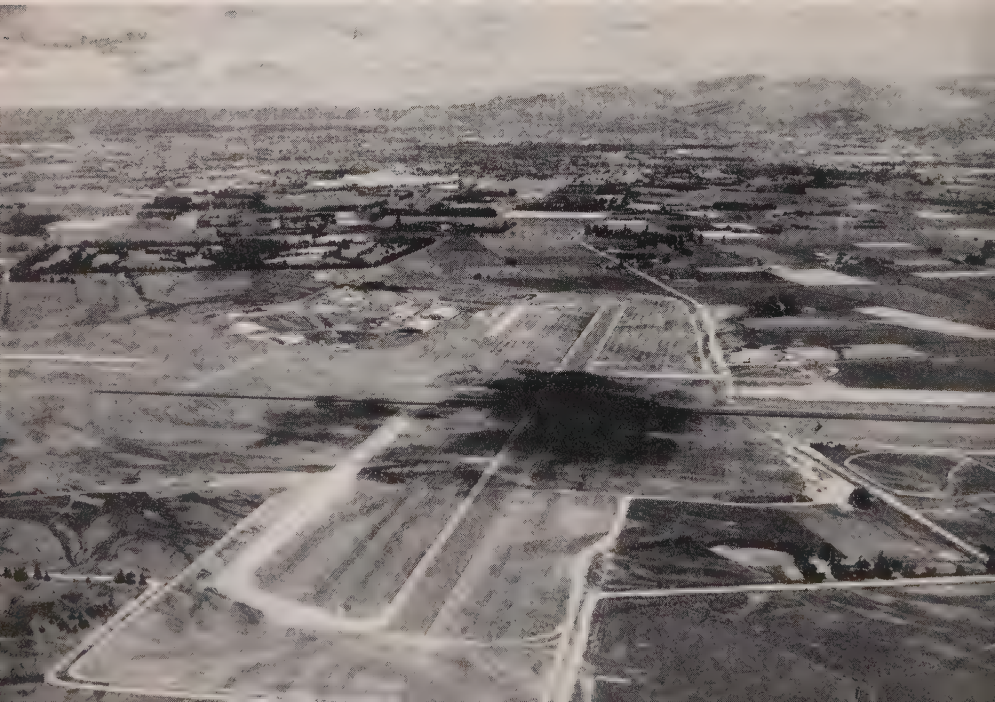


Fig. 2. *From Mechanics Bay, close to the heart of Auckland, Solent flying boats of TEAL take off for Sydney, Fiji and Tahiti . . .*

## TERMINAL POINTS IN NEW ZEALAN

Fig. 3. . . . *Whilst from Harewood, near Christchurch, TEAL operates a landplane service to Melbourne.*

*Photos:* Whites Aviat



Figs. 4 and 5. *From Auckland and Wellington flying-boats converge on Sydney and land at Rose Bay in the far southeastern reach of the harbour. Nandi in Fiji is a transpacific staging-post whence DC6's of BCPA, Stratocruisers of PAA, and DC4's of CPA diverge to either Australia or New Zealand.*

*tos:* Whites Aviation

INTS OF DEPARTURE TO NEW ZEALAND

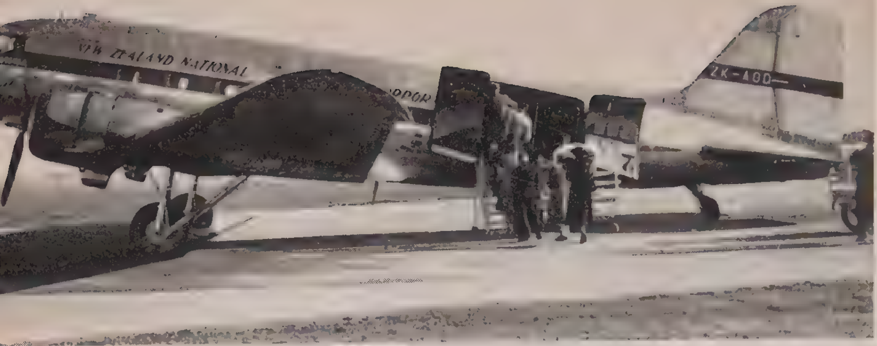
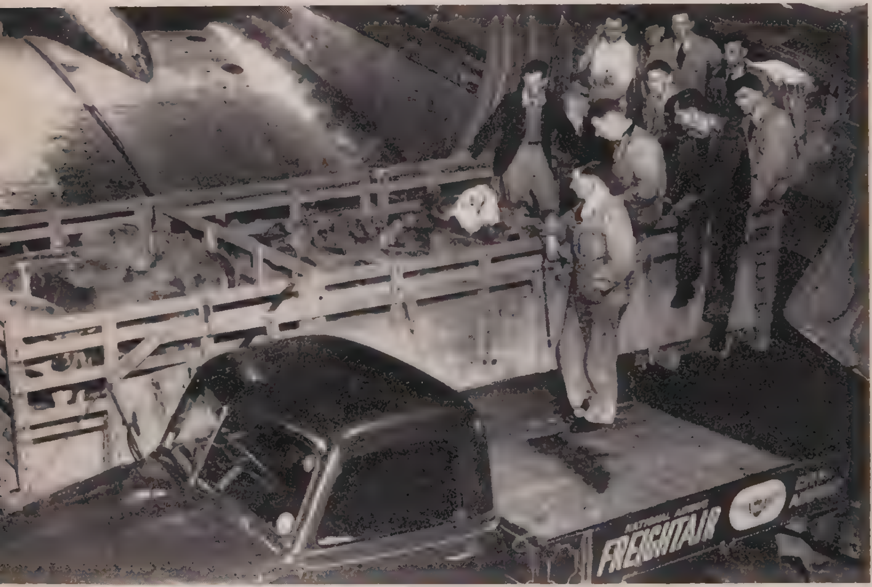


Fig. 6. *Passenger services within New Zealand and to Pacific island territories.*

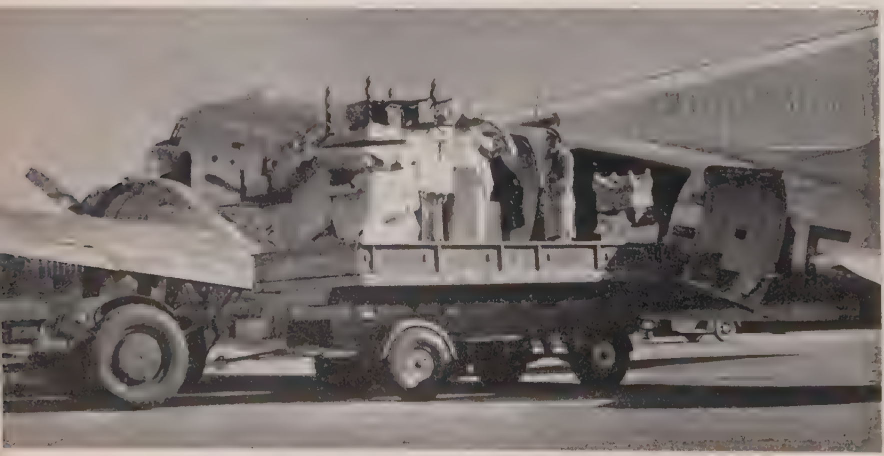


*Photos:* National Airways Corporation

Fig. 7. *Freight services, including consignments of stock.*

Fig. 8. *The rail-air service across Cook Strait.*

*Photo:* National Publicity Studios



ROUTINE FLIGHTS BY DAKOTAS

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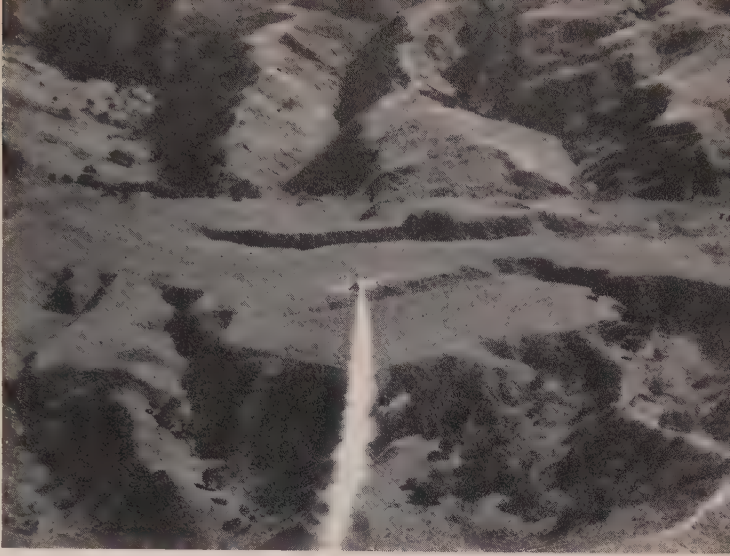

Fig. 9,
*Topdressing in the Wairarapa.*

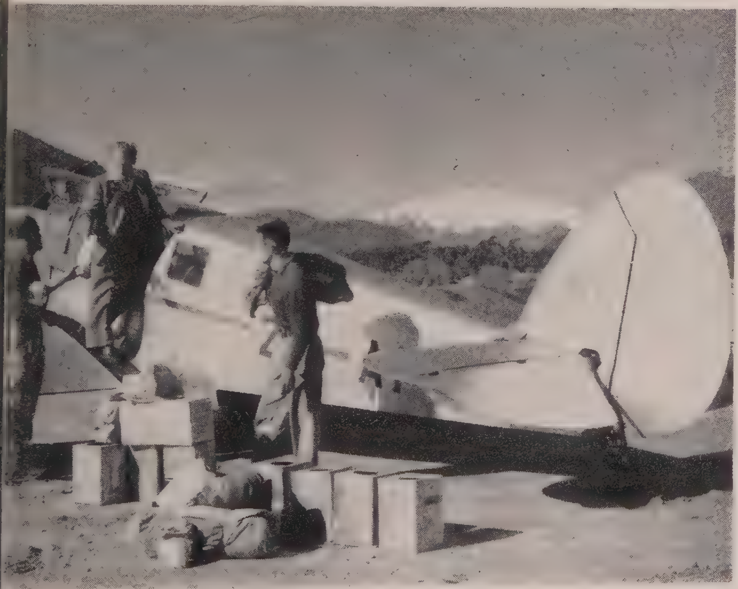

Fig. 10.
*Whitebait from South Westland.*

Fig. 11.
*Tourist trips at Queenstown.*

National
Publicity Studios

# NEW ZEALAND GEOGRAPHICAL SOCIETY: BRANCH AFFAIRS

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*Hon. Auditor:* Mr. W. Rosenberg

*Committee:* Miss N. Clark, Mr. W. J. A. Brittenden, Mr. W. J. Clark,
Mr. J. K. Cunningham, Mr. M. McCaskill

Mr. B. W. Collins opened the 1952 programme of lectures with an address to the March meeting on 'Ground-water Resources of Canterbury'. At the April meeting Dr. W. R. Philipson described a botanical expedition into Central Colombia. A film evening on Canada was arranged for May, with an introduction by Professor J. C. Garrett, and a talk on 'The Gold Coast' by Mr. W. W. Sawyer was given in June.

Film evenings have been arranged to supplement the lecture programme. In March, a series of films on soil conservation were shown with a commentary by Professor L. W. McCaskill. A second film evening was arranged in May to give members an opportunity to see two films on the Antarctic introduced by Dr. J. S. Cumpston. Further film evenings were held later in the year.

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*Committee:* Mrs. S. S. Turner, Mr. G. D. Anderson, Mr. H. A. Franklin,
Mr. P. Hickson, Mr. W. M. Jones, Mr. A. J. Sligo

Meetings of the Wellington Branch have been held as follows: March—Mr. H. S. Franklin, 'Birmingham and the Black Country'; April—Mr. V. Lakshmipathy, 'Thailand'; May—Mr. Rabbani, 'Pakistan'; June—Dr. J. S. Melville, 'New Zealand Grassland Survey'; July—Dr. W. B. Sutch, 'The Danube Basin in 1952'; August—Miss N. M. Wilkins, 'County Planning in Southeastern Scotland'; September—Members' Evening; October—Film Evening, 'El Dorado'.

There has been a welcome improvement in attendance at meetings, with increased participation by junior members. The junior membership scheme, under which any school may form a group under the auspices of a member of the staff, offers much promise. Next year the branch will return to its usual Wednesday evening meetings.

## AUCKLAND BRANCH

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Mr. L. Lucena, Professor W. R. McGregor, Mr. L. K. Munro,
Professor R. O. Piddington, Miss E. E. Stephens

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*Deputy-Chairman:* Mr. F. H. Bishop

*Hon. Secretary:* Mr. B. H. Farrell *Hon. Treasurer:* Miss A. M. Gorrie

*Hon. Auditor:* Mr. J. K. Bedbrook

*Committee:* Mrs. J. Collins, Miss J. Metge, Mr. K. B. Radford,
Mr. F. Richardson

The lecture programme for 1952 included the following: Professor K. B. Cumberland, 'The Land and the Future'; Professor E. M. Blaiklock, 'Some Aspects of the Geography of England during Roman Times'; Mr. L. W. Larsen, 'Weather Organisation and Forecasting for International Air Lines'; Dr. E. P. Neale, 'Population of New Zealand Towns'; Mr. Noel B. Lendrum, 'International Air Transportation'; and an Honours Students' Evening. Lectures have been well attended and there appears to be a growing interest in branch affairs. The Society's annual general meeting was held in June, and the speaker was Sir William Jordan.

In March a most successful excursion led by Mr. E. Searle visited Muriwai Beach, an area of particular interest to both geographers and geologists. It is hoped in the future to arrange similar excursions more frequently.

## OTAGO BRANCH

OFFICERS for 1952 are— *President:* Mr. W. E. Earnshaw

*Past-President:* Mr. A. H. Payne

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Mr. M. G. McInnes

At the annual general meeting for 1952 the president, Mr. A. H. Payne, delivered an address on 'Outlook for Iran'. In April the branch heard an informative talk by Mr. J. Finkelstein on 'Recent Advances in Meteorology'. The scheme for Junior Members has met with a successful response and meetings are well attended by this group. In June an excursion was held to the site of the new hydroelectric power station at Roxburgh, and an interesting programme of lectures and film evenings has been arranged for the rest of the year.

# GEOGRAPHIC NOTEBOOK

CONTRIBUTORS TO THIS ISSUE. No New Zealand geographer has yet turned his attention to the dominion's offshore marine resources, and little material is available on the fish supply and fishing industry other than in the brief, statistical annual reports of the Marine Department. Dr. Donald Patton's contribution is therefore especially welcome. In this issue Dr. Patton, a graduate of Harvard, now Assistant Professor of Geography at the University of Maryland and formerly Visiting Lecturer in Geography at Canterbury University College, places New Zealand's fish resources and fisheries in their world setting and evaluates them in relation to those of other nations. In a subsequent number of the journal he will analyse the dominion's fish industry in more detail by specific reference to ports, methods and kinds of fish.

In recent issues the *New Zealand Geographer* has published articles on the historical geography of the country at a time when the Maori people still considerably outnumbered the newly-arrived European whalers, missionaries and settlers. Since that time the Maori population has declined in numbers and subsequently increased again until there are today 120,000 Maoris—one to every sixteen Europeans. The Maoris thus play an increasing part in the economy of the dominion and make a growing contribution to the character of the areas in which they dwell. In this number Miss Joan Metge, last year a graduate student and now temporary Junior Lecturer in the Department of Geography at Auckland University College, describes in words and maps the distribution of the greater part of the Maori population in her account of the Maoris in the Auckland Province and points to the contribution they make to the agricultural, timber-milling, tourist, fertiliser and other industries in both town and country.

Dr. M. M. Burns, formerly Director of the Otara Research Station of the New Zealand Fertiliser Manufacturers' Research Association, and now Director of the Canterbury Agricultural College at which he was once lecturer in soils, writes authoritatively on the fertiliser industry, on the basic importance of fertilisers to New Zealand's pastoral economy, and on current research in the chemistry of artificial fertilisers. Mr. D. W. McKenzie, Senior Lecturer in Geography at Victoria University College, presents an interesting comment on aerial photographs and topographic maps.

For teachers of geography in New Zealand schools the *New Zealand Geographer* inaugurates in this number a series of pedagogic discussions on *Geography in Schools,* and under that separate title publishes two statements—one on geography and social studies in the primary school by Mr. J. H. Martin, Lecturer in Geography at the Auckland Teachers' Training College, and one on the comparative position of geography in the sixth forms of English and New Zealand post-primary schools by Mr. J. L. Hewland, Chairman of the Council of the Society, geography master at the Christchurch Boys' High School, and a previous contributor of articles to the *New Zealand Geographer.*

*Photogeography* depicted last time the railways of New Zealand. In this issue it pictures the dominion's air-transport industry—internal and external. The short article accompanying the photographs is written by a graduate student of the Department of Geography at Auckland University College, Mr. F. H. Bishop, now doing research on the internal airways system of the dominion and whose substantive contribution will be published at a later date.

Among other contributors—of reviews, short notices and comments—to this number are: Dr. J. C. Beaglehole of Victoria University College; Mr. J. W. Hutchings and Mr. N. G. Robertson of the New Zealand Meteorological Office; Mr. C. R. Straubel, Editor to Messrs. Whitcombe and Tombs Ltd.; Mr. A. J. Rose of New England University College, N.S.W.; Mr. N. H. Whatman of Ardmore Teachers' College; Miss Mary B. Kibblewhite of the University of Otago; Mr. A. D. Tweedie of the University of Queensland and formerly of the University of Otago; Mr. A. M. Stephens of Barrhill, Rakaia; and the editorial staff.

THE NATIONAL ATLAS. For more than fourteen years now students of the social sciences in New Zealand have looked forward to the publication of the national atlas undertaken as one part of the centennial surveys of 1940. From time to time brief reports of progress were received, although no tangible evidence of publication at an early date was forthcoming. Yet this very delay was interpreted as an indication of the wealth of research and scholarship being called upon to ensure that the atlas would be a publication of the finest quality. Meanwhile all interested entertained high hopes, and in 1945 Dr. G. Jobberns, Professor of Geography at Canterbury University College, while regretting the prolonged deferment in its publication, described the atlas as 'a cartographic pageant of our national development . . . designed to portray what we had achieved in our century of occupation of the country' (*New Zealand Geographer,* Vol. I, No. 1, 1945, pp. 10-11).

Now it is reported that work on the atlas has virtually ceased, and that Dr. J. C. Beaglehole, under whose supervision the work was proceeding, has been relieved of his appointment as head of the Historical Branch of the Department of Internal Affairs. Moreover, some time ago, Mr. R. I. M. Burnett, secretary of the committee directing the work and its chief executive, thoroughly disheartened, resigned his post. And with the departure of these two scholars, who between them combined rare ability, the work of years has been rendered fruitless. Many students of New Zealand affairs are therefore perturbed as to the fate of the atlas and of the work already accomplished.

The institution of projects of this kind presupposes that they will remain unaffected by changes of government, otherwise research would be largely nugatory and no scholar could be induced to participate. This centennial atlas is an undertaking that must transcend all petty political bickerings, so valuable is its contribution to the history and geography of this country. That the atlas has received official and public support in the past is without question, and if it is now decreed officially that the project must be set aside, the public generally and the academic world in particular require to be persuaded that this must be so.

The war, of course, prevented the early completion of work already under way. Since 1939 only a skeleton staff has been employed, and frequent changes of personnel have not contributed to speedy developments. But, more important, countless other scholars and research workers, all of them authorities in their respective fields, have given freely of their time and knowledge. Specialists in government departments have also played their part. Consequently the bulk of the arduous research necessary for the preparation of the maps has been completed; they now await the draughtsman and the printer. Yet they cannot wait too long. Delay will mean that the atlas will become merely historical and its appeal will be correspondingly reduced.

The lack of an atlas constitutes perhaps the most serious gap in historical scholarship in New Zealand. In geography the need is just as great, particularly in view of the vast amount of excellent material that lies uncoordinated and often unseen—and is certainly inaccessible to the layman—in the files and map drawers of many government departments. Nevertheless, urgent though publication may be, it is vital that at this final stage the government should not be induced to present an incomplete and inadequate atlas. Too many valuable years of devoted work and too much money have gone into its compilation for the atlas not to rank as a first-class contribution to the picture of New Zealand past and present.

If, now that its head has gone, the Historical Branch of the Department of Internal Affairs is to pass away, other avenues of collation, coordination and publication may have to be found. The University of New Zealand with its research facilities, as well as academic societies, could undertake these tasks with government aid, although specific assistance from the Department of Lands and Survey would be essential in any case. But no matter what the means, the centennial atlas must be published in a suitable form, and it is hoped that the government will make a fuller and more definite statement on the matter than that which appears in the annual report of the Department of Internal Affairs for the year ended 31 March 1952 (*Append. Journ. House of Repres.*, (H-22), Wellington, 1952, p. 31). Here is the bald, inadequate intimation that 'research and letterpress have been completed for the European population maps to 1911, and work on the series of Maori population maps and accompanying letterpresses is almost finished.'

DROUGHT IN AUSTRALIA. The summer of 1951-1952 was one of immense losses to Australia's primary industries. In a great arc from the Kimberleys in the far northwest to the eastern mountains of Victoria fires swept the land and heat dried the water holes. In the north the usual summer monsoon failed to break until early in January, accentuating the effects of an extremely dry winter and an unprecedentedly hot spring. During November a million square miles of continent shimmered under a haze of smoke, and navigation by sea and air along the eastern seaboard was impeded. Fire destroyed the accumulated growth of previous lush seasons and made deep inroads into the slender forest reserves of the continent. Livestock, fences and homes were destroyed by this more spectacular result of a drought which pressed ever more heavily upon the land, slowly withering and killing plants and animals which had escaped the flames. No full assessment of the damage has yet been made and no clear overall picture of the situation can be gained from the state-centred metropolitan newspapers.

The area hardest hit of all was the broad coastal belt extending from the vicinity of Sydney 1800 miles north to Cairns. Usually this area receives copious rain. But in 1951 the rains failed and crops and pastures adjusted to humid conditions wilted as climatic conditions more typical of the arid interior spread across the ranges and down to the shores of the Pacific. The seared brown of southeastern Queensland in December could hardly be recognised as the land of fresh green plants and grasses seen only seven months earlier. Sugar production declined almost twenty percent. Hay, vital to the maintenance of dairy herds, sold at £35 to £40 a ton in the drought-ridden areas.

Some herds were totally destroyed by lack of fodder and water. City milk supplies were cut and butter production fell. To meet essential needs, many towns were forced to carry water tens of miles. Even in suburban Sydney, homes were destroyed by forest fires, and in late January a series of blazes swept the southern coast of New South Wales. Fanned by strong winds, these fires in a few days caused damage amounting to £5 million; an estimated 30,000 cows and 100,000 sheep were destroyed. The one bright point of the season was the exceptionally high quality of the wheat crop in New South Wales, which was also heavier than predicted.

It may be that the drought will have unexpected long-term effects. It has served to underline heavily not only the relative but also the absolute importance of pastoral and agricultural production to a highly urbanised nation whose basic source of wealth is still the soil. High prices and actual food shortages in the cities have brought home this fact to every city dweller, while the current reduction of imports further points to the need for increased rural production. This growing awareness is reflected in all newspapers and in ministerial pronouncements. The aim is to increase rural production to an extent where the margin of surplus exceeds the needs of a rapidly expanding population while at the same time providing Australia's principal source of outside currency. There can be no doubt of the tremendous scope for increasing production from already occupied land by the full application of known techniques. Various economic steps are being taken to stimulate this potential increase, steps which have been hurried by the recent disasters. The recent decline of wool prices may also aid the expansion of food production, especially of meat production which has been stationary at about one million tons since 1938. The era of cheap food for Australian city dwellers seems definitely to have ended. Increased home consumption set against a gradually declining rural production means a rapid shrinkage of export income. The drought has served to hasten this trend and has consequently helped to foster what may be a fundamental readjustment of the Australian economy. Australia may yet regain her vanishing importance as a supplier of the world's food markets.—A. J. Rose

HURRICANES IN THE SOUTHWEST PACIFIC. The recent occurrence of a tropical hurricane in the Fiji Islands, with its attendant toll of death and destruction, serves to throw into sharp relief a special and characteristic phenomenon of the tropical parts of the earth—the hurricane or tropical revolving storm. The word 'hurricane' is thought to be derived from a Carib Indian word meaning 'big wind' and, whether this be true or not, a wind of destructive force (usually accompanied by torrential rain) is certainly the most important characteristic of the hurricane.

Up to 1698 little was known of the cause of these winds but in the *Philosophical Transactions* for that year Langford put forward the suggestion that a hurricane was really an intense circular vortex of air somewhat analogous to the tornado or waterspout but on a very much larger scale. Thus, while the destructive width along the track of a tornado is usually only a fraction of a mile, the destructive influence of a hurricane may extend for fifty to a hundred miles on either side of the track, and the area of gales may extend over thousands of square miles. This view is now known to be substantially correct. Indeed, perhaps the clearest view of the mechanism of the hurricane is to be obtained on the analogy of the tiny whirls of water sometimes seen on a slowly moving stream. These vortices rotate relatively rapidly around a centre and, at the same time, have a progressive motion depending on the general current in the stream. This motion is, however, slow compared with the velocities developed by the rotation of the fluid and this is in general true also of hurricanes. At the very centre of the hurricane there is also (as might be expected from the water analogy) an area of calm or light variable winds—the well-known 'eye' of the storm.

Tropical hurricanes occur with varying frequency in most parts of the tropics but are especially well-developed over oceanic areas. They are very frequent in the region of the China Sea, where they are known as typhoons, while many occur in the West Indies, the Gulf of Mexico, the Bay of Bengal, the Arabian Sea, the south Indian Ocean and the tropical parts of the north and south Pacific. Owing to the economic importance of their destructive effects in the southern United States, the West Indies and the Gulf of Mexico hurricanes have been thoroughly studied. Military necessity has also contributed to our knowledge of north Pacific hurricanes. In the latter case the new technique of aircraft reconnaissance has brought to light many new facts on the detailed structure of these storms.

In the south Pacific, however, despite their obvious importance as a factor in the lives of the inhabitants of Pacific islands, little has been done to study their occurrence and characteristics. The pioneer work of Visher was published in 1922 ('Tropical Cyclones in Australia and the South Pacific and Indian Oceans', *Monthly Weather Review*, Vol. 50, No. 6, June 1922) and included information from the tropical area between 160 degrees east and 140 degrees west. Lacking adequate data for the preparation of synoptic weather charts, Visher collected data on the frequency of storms occurring in the various island groups, and by a combination of such statistics deduced storm frequencies for the entire area. However the information was very scanty for most areas and most years, and in order to avoid seriously underestimating the number of hurricanes occurring, Visher thought it wise to include all reports of winds of gale force as an actual hurricane. With regard to the tracks followed by the hurricane centres only very schematic reconstructions of the paths were possible with the limited material available.

From about 1940 on, however, the weather services in the southwest Pacific were greatly expanded and in some areas military operations resulted in a very dense network of weather stations as well as in the receipt of numerous weather reports from ships and aircraft. The characteristics and distribution of hurricanes in the southwest Pacific are now being closely investigated, using the period 1940-1951 for which adequate synoptic charts are available. Although this study is not yet complete one can hardly avoid the conclusion that there is great variability in the intensities of tropical disturbances. Indeed it is probable that there exists a continuous spectrum of storm intensity ranging from barely detectable disturbances with winds of five to ten knots, to the most intense hurricanes where winds may exceed 100 knots. Thus it appears probable that the statistics given by Visher for gale-producing disturbances would lead to a considerable overestimate of the number of disturbances of full hurricane strength. Actually this appears to be the case. Visher concluded that 'the total number of severe tropical cyclones damaging these island groups appears to average about twelve a year' but preliminary figures for the twelve years 1940-1951 give only forty storms which could be considered to have reached full hurricane strength. This is an average of only three or four hurricanes per year for the entire tropical area south of the equator between 150 degrees east and 150 degrees west. Nevertheless, the circle of hurricane winds is often very narrow and it is sometimes not possible to determine whether a given disturbance should be classed as a hurricane or not. It is therefore probable that the true frequency of actual hurricanes in this area will be found to lie somewhere between the figures found by Visher and those given above.

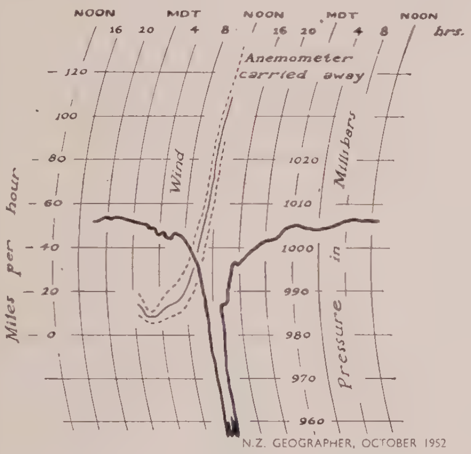

*Fig.* 1. A diagrammatic reproduction of the barograph chart which recorded the passage of the hurricane at Lauthala Bay. On it anemometer readings have been superimposed.

The comparative narrowness of the belt of hurricane winds may be illustrated by the Fiji hurricane which was centred over Suva shortly before noon on 28 January 1952. The figure shows the record of atmospheric pressure and wind speed obtained at the Lauthala Bay meteorological station, about a mile from Suva. The wind speed is shown by three curves; the upper graph gives the upper limit reached in the gusts, the lower graph gives the speed recorded in the lulls while the middle curve gives the average wind speed. It will be seen that in the space of about two and a half hours the average wind speed increased from forty to 110 miles per hour, while at the same time the pressure decreased from 997 mb. to a minimum of 957 mb. in the centre of the storm. The forward motion of the storm at this time appears to have been about twenty miles per hour so that the diameter of the central core of winds with speeds greater than forty miles per hour was not more than about 100 miles. It would thus seem that to identify a hurricane with certainty a very dense network of stations would be necessary. Failing that, the technique of aerial reconnaissance could probably be used with some advantage.—J. W. HUTCHINGS

WHEAT ACREAGE: A FARMER'S APOLOGIA. With an estimated 95,000 acres under cultivation in 1951-1952, New Zealand has reached a nadir in wheat production. Not since 1875 has the acreage under wheat fallen so low. Serious alarm has been expressed in many quarters because the dominion from its own resources cannot meet the demand for wheat, but the farmer, concerned with good husbandry and economic returns, can find reasons to explain the decline. Despite the fact that there are large potential wheat-growing areas in both the North and the South Islands, the Canterbury Plains have been the centre of wheat production for the last eighty years or more. Consequently much of this area is now becoming so 'wheat-sick' that the yields do not compensate the farmer for the depletion of the fertility of his soils. He can grow grasses and clover or other crops that exhaust the soil less than wheat. Moreover recent wool and meat prices have made sheep farming a more paying proposition. With sheep, too, the working of the farm is easier and less expensive, and the soil is maintained in better heart because increased animal manure is returned to it, and because it has carried a leguminous crop. The grass-clover paddock not only feeds sheep and receives manure from them but also may provide a cash crop of grass or clover seed—a development which has been a feature on the lighter land of the plains during recent wet seasons.

If a grass ley is to be ploughed up, the disadvantages of sowing it in wheat are clear when the farmer compares his returns from other crops. To make sure of a good crop of wheat, free of weeds, and to give the old grass time to rot, the grass should be skimmed in December or early January, deep-ploughed in April and sown in May; for most other crops ploughing is not necessary till June, thus the grass may be used for six months more. The earlier ploughing for wheat usually means that the ground dries hard, involving extra cost in ploughshares and mouldboards. On the other hand, in the summer and autumn of 1950-1951 the ground was so wet that early ploughing for wheat was impossible on much of the good wheatland of Canterbury.

When receipts per acre from different crops are compared, wheat, at forty-five bushels to the acre and ten shillings a bushel, means £22 10s. 0d. per acre; on the same land, oats, which do not rob the soil so much, can be reckoned at sixty bushels per acre and nine shillings a bushel—or £27 per acre; malting barley, sixty bushels per acre at seven shillings and fourpence a bushel and very easy on the soil, produces £22 per acre; partridge peas, a leguminous crop which adds to the soil's fertility, can be expected to produce forty-five bushels at £1 per bushel or £45 per acre; whilst linseed at £50 per ton should return between £30 and £40 per acre. Obviously, then, wheat at ten shillings per bushel is not a popular crop with the Canterbury farmer, especially one who cares for his soil. Wheat cannot compete today with higher returns from other crops which do not exhaust the soil, nor, when the cost of implements and labour, labour shortages at all stages of cropping, and the easier work are taken into account, with sheep fattening under present conditions. If the wheat acreage is to be increased the farmer must be given a greater incentive, but taxation today would destroy this incentive even if a higher price for wheat were given. Perhaps the acreage would rise, and the high cost of importing wheat be removed, if, instead of paying a higher price, the government exempted the proceeds of wheat growing from income tax. There is, and always has been, of course, the danger of making wheat growing too attractive to the man who is willing to mine his soil instead of farming it, but the city dweller who wants cheap bread and freedom from restrictions cannot reasonably ask the farmer to accept restrictions to prevent soil depletion.—A. M. STEPHENS

REFRESHER COURSE IN SOCIAL STUDIES. Elsewhere in this issue of the *New Zealand Geographer* Mr. J. H. Martin has made a plea for a more thorough appreciation of the part the teaching of geography can play in the primary school, even though it may fall under the generic head of 'social studies'. It is therefore interesting to reflect on the attempts that have been made to acquaint teachers with the 'philosophy' of this symbiotic concept, especially in view of the fact that it is the older members of the profession who exert the greatest influence on teaching methods, whilst at the same time often cherishing ideas that are tantamount to prejudices.

In January 1952 two refresher courses in social studies were organised by the Refresher Course Committee of the Education Department, one being held at New Plymouth and the other at Oamaru. The smooth running and happy atmosphere of these courses reflect great credit on those responsible for their administration and on the respective chairmen, Mr. Duncan McKay and Mr. A. J. Campbell. Lectures, discussions, and the exchange of experiences at courses such as these benefit all who can take the opportunity to attend.

Yet in the case of these two latest courses, serious misgivings must be aroused as to their efficacy from pedagogical and methodological points of view. At neither course was a fully qualified geographer given the opportunity to present an interpretation of the geography which is now firmly established in the post-primary schools of this country and which has received its stimulus and fashioning from the University. On occasions, indeed, a concept of geography was advanced which bore no resemblance to the discipline as it has evolved in New Zealand during the last ten to fifteen years. Following the pattern set by the 1928 syllabus, many ideas expressed were frankly deterministic, and this would surely suggest that in many primary schools today children are still being taught a 'cause and effect' geography totally divorced from reality.

Others, aware of the later syllabus in social studies, but not understanding it, considered that geography had lost its identity and that some strange amalgam of topics had been evolved. This was pernicious enough in itself, but it also became evident that social studies interpreted in this way by teachers who understood history but not geography became, in effect, social history embellished with the outworn, threadbare trappings of an old-fashioned geography.

Consequently, with misconception so widespread—and this state of affairs must surely have become apparent during the five years the social studies syllabus has been implemented—it was singularly unfortunate that no geographer was called upon to redress the balance. Mr. G. Anderson alone was able to make a worthwhile contribution, but that was in the restricted field of visual aids. The teaching of social studies, like that of any other subject, demands that teachers be well-informed and appreciate fully the implications of the syllabus prepared for them. It is doubtful whether many yet have that understanding or are permitted to show it, and certainly many of those who attended the refresher courses did not achieve it to any great extent.—N. H. WHATMAN

NEW ADMIRALTY CHARTS. During 1951 three new admiralty charts were published by the Hydrographic Branch of the Department of Lands and Survey and were issued by the New Zealand Naval Board. They are the results of surveys carried out in 1950 and 1951 by H.M.N.Z.S. *Lachlan* and are worthy examples of the neatness and precision to be expected of such charts. The land is distinguished by light-green tinting overlaid by details of natural and cultural features in black. Form lines are used to indicate the character of the surface configuration and prominent features of aid to navigation are also marked. Marine detail varies from sheet to sheet, soundings, for example, being in either fathoms or feet according to the scale of the chart. Shallow water is denoted by blue tinting, and shoals are edged in the same colour, lights and beacons are marked in red, and in addition a host of information is plotted in black.

The chart of Wellington Harbour (N.Z. 50) on a scale of 1 : 25,000 illustrates vividly the narrow entrance to Port Nicholson, whilst that of Bluff Harbour (N.Z. 53) on a scale of 1 : 10,000 demonstrates the problems of port location extremely well. The third chart is of Cook Strait (N.Z. 23), on a scale of 1 : 200,000 and covering the quadrilateral marked by Cape Stephens, Cape Campbell, Cape Palliser and the mouth of the Rangitikei River. It is interesting to note that this last chart is drawn on the mercator projection whilst the larger-scale charts are on the gnomonic.

MINING IN OTAGO: GOLD AND SCHEELITE. The mining of gold has had a colourful history in all countries where it has been found, but as a 'robber industry' its significance in any economy has been hardly permanent—though, of course, exceptions do exist. Moreover in these days of advanced technology other minerals are perhaps more sought after—not only uranium ores but also those deposits which contain elements important in the manufacture of special steels. Scheelite is one of these. Consequently the development and exploitation of gold and scheelite deposits in New Zealand reveal interesting contrasts in their reaction to world economic and political conditions, and in the success and the scale of their operations.

Mainly because output was from large-scale dredging and quartz mining, the total annual production of gold in New Zealand did not fluctuate widely during the first forty years of this century. Since 1940, however, a steady decline has been evident, a decline which culminated in 1950 in a sharp fall of 41,245 ounces. Average output is now less than 50,000 ounces a year, and despite the increased price of gold on the world market it appears that costs of production by present methods cannot be met.

The most significant feature of this reduced output is the virtual cessation of quartz mining with the closing down of the Blackwater mine in Westland in July 1951 and of the Martha mine at Waihi in June 1952. At the end of January 1952 the Lowburn dredge ceased operations too, indicative of the fact that the general decline in gold production is not confined solely to quartz mining. One of the largest in the world, the Lowburn dredge was designed to handle two and a half million cubic yards of gravel a year, but because its capacity was restricted by frequent shortages of power, the dredge never recovered more gold than was needed to meet expenses. Dredging in Otago, moreover, has recently had to face the opposition of catchment boards and pastoral interests, though no direct government action has been taken. However, the granting of a licence at the beginning of 1951 to mine the Cromwell Flat by tunnelling from the Kawarau River, and experiments with earthmoving equipment at Blue Spur near Lawrence later that year, would suggest perhaps that new methods and machinery may replace uneconomic working by older methods.

The mining of scheelite, a source of tungsten, is confined mainly to a small area at the head of Lake Wakatipu, though small deposits do occur at Macraes Flat in eastern Otago and in Marlborough. Once thrown aside as a useless mineral along with which gold was found, scheelite rose in price from £64 a ton in 1927 to a maximum of £2500 in immediate postwar years, and now remains steady at £1800. Nearly fifty tons were mined in 1951, almost double the average of the past few years. Practically the entire output is exported through Invercargill, most of it to Great Britain and a small quantity to the United States. Only fifty men are employed on the scheelite fields. Singly or in small groups, they work claims four to seven thousand feet up on the steep slopes of Mount Juda above Glenorchy, mining being confined to the summer months. One mine only possesses modern equipment, and the generally primitive nature of the mining may be related both to the small deposits and to the wide fluctuations of price in the past. This insecurity caused promising claims to be abandoned from time to time. Yet with the cutting off of supplies of scheelite from China and other sources, a steady demand seems assured. If difficulties of access and transport can be overcome the Glenorchy scheelite mines may become a highly-organised enterprise, although the very smallness of the known deposits may limit the scale of operations. Nevertheless prospects are much brighter than those in the Otago gold-mining industry.—MARY B. KIBBLEWHITE

EARLY TEXTBOOKS OF GEOGRAPHY IN NEW ZEALAND. The note by Professor K. C. Edwards in the *New Zealand Geographer,* Vol. VII, No. 2, October 1951, concerning D. Petrie's *Geography of New Zealand and Australia* published in 1878 draws attention to a neglected aspect, not only of the history of the teaching of geography in New Zealand, but of the history of education in this country. Surprisingly little is known about the textbooks which our fathers and grandfathers used. Yet there can be no question of the value of a study of changes in the teacher's concept of the nature of a subject or of changes in the manner of teaching it. For such a study the textbook is essential material.

The standard school textbooks of geography issued in England in the mid-nineteenth century dismissed New Zealand in a few words or paragraphs. When the New Zealand provincial education systems were developing in the 1860's, teachers here obviously felt that their pupils should know something about their own country even if it were no more than a list of towns, rivers and mountains. So in Dunedin, Christchurch, Wellington, Napier and Auckland inspectors and leading teachers began to produce their own supplementary textbooks which dealt with local aspects of their subject. That their concept of geography was limited is, as Professor Edwards has stated, typical of the period and not confined to New Zealand.

There are, however, wide differences among these early locally-produced geographies. There were many of them—at least five (six, if one originating in Australia is included) before the particular work of Petrie's referred to by Professor Edwards.

The following chronological list for the period up to 1889 has been drawn up to assist any who may wish to make a more thorough study of these early textbooks. The list is certainly incomplete but it includes all that are named in Hocken's *Bibliography of New Zealand Literature*, together with others that have been collected by inducing secondhand booksellers not to throw away early textbooks. The first two references are based solely on Hocken's description since copies of these two books have not yet been obtained.

1856 *A School Geography of Australia and New Zealand.* By J. Bonwick. Melbourne: George Robertson, pp. 212.

1866 *A School Primer of the Geography and History of Oceania, for Young People.* By J. B. Park. Published under the Patronage of the Otago Education Board. Dunedin: A. R. Livingstone, pp. 53.

1868 *A Geography and History of New Zealand, for Use of Schools.* By James Wylde, Christchurch: Ward and Reeves, pp. 43.

1869 *Manual of New Zealand Geography, with Maps and Examination Questions.* By T. A. Bowden, Inspector of Provincial Schools and Mathematics Master of Wellington Grammar School. Assisted by James Hector, M.D., F.R.G.S. London: George Philip and Sons, pp. 143.

1871 *Elementary Geography of New Zealand.* By G. Willmer. Christchurch: Jones and Tombs, pp. 30.

1877 *Geography of New Zealand and Oceania.* By Rev. Peter Mason, B.A. (Sixth Thousand). Auckland: Upton and Co., pp. 48.

1878 *Geography of New Zealand and the Australian Colonies.* By D. Petrie, M.A., Inspector of Schools to the Otago Education Board. Dunedin: Henry Wise and Co., pp. 77.

1884 *Geography Adapted to Standards II, III and IV.* By Henry Hill, B.A. (Eighth Thousand). Christchurch: Whitcombe and Tombs, pp. 96.

1884 *A Geography of New Zealand and Australia,* with Four Maps. By. J. J. Patterson, B.A. Christchurch: Whitcombe and Tombs, pp. 128.

1889 *A Geography of New Zealand for Schools.* By D. Petrie, M.A. (Revised Edition). Dunedin: Wise, Caffin and Co., pp. 60.

For some of these books there were almost certainly earlier editions than those listed here. Mason's, for example, is labelled 'sixth thousand' in 1877. Hill's is 'eighth thousand' in 1884, although the 1884 edition was the first school textbook published by Whitcombe and Tombs. It is possible, although not certain, that this book was first published in Napier, where Hill was inspector from 1878.

Among these books two are outstanding. Bowden's *Manual of New Zealand Geography* is a substantial work, really comprehensive for its period and illustrated by ten inset folding maps. In its first part, titled 'General Geography of the Colony', it is distinguished by useful chapters on early history, geology, meteorology and climate, natural history and native inhabitants. Apart from these chapters, however, the geographical description is in the main no more than a mere list of physical features.

Suggestions of a more modern concept of geography are contained in the introduction to Hill's *Geography Adapted to Standards II, III and IV*. This is not a geography of New Zealand, but a general introduction to the subject. In its early pages it reveals more of the modern approach than is contained in any other of these books. Hill writes, for example: 'The topography of each school district, if rightly taught should form the stepping-stone to the geography of New Zealand.' In the text of the book itself Hill proceeds from the teaching of direction to the nature of a plan, and thence to the actual drawing of a plan of the schoolroom. His mapwork section is further illustrated by an elevation sketch and accompanying plan of a group of buildings in a village. Even Hill, however, becomes little more than a cataloguer when he has to give a brief treatment of individual countries. His introduction refers to a second book, his *General Geography of New Zealand,* but a copy of this has yet to be discovered.

Of the other books little need be said. Wylde's is a catechism with the answers to be learned by heart. Willmer's is rather better than the average—it even hints at land use. Mason's is essentially a list of physical features. Petrie's 1878 book has been described by Professor Edwards; his 1889 version merely leaves out Australia. Patterson's book, although larger, is very similar to Petrie's. Beyond such statements as 'Tauranga, the centre of a rich farming district' there is little to indicate that the writer thought of geography as being concerned with man as well as with rocks and rivers.—C. R. STRAUBEL

[Mr. Straubel has drawn attention to a noteworthy topic for research. Those members of the Society who have read his interesting statement will probably now recall old school textbooks hidden away in attic or cellar, or lodged on the top shelf of the bookcase. A collection of such textbooks of geography would be a most valuable source of information about the history of geography in New Zealand. Although the work of geographers from Cook and Forster to Hochstetter and von Haast is preserved in well-known and readily-available books and journals, little material relating to the geography taught in New Zealand schools is to be found except by wide and laborious searching. If, however, the Society could collect together examples of early school textbooks it would be providing foundations for research by some future historian of New Zealand geography. With this in mind, it might be suggested that members with copies of such books should consider presenting them to the Society's library. The librarian would be pleased to assemble them, preserve them, and make them available to any student of the history of New Zealand geography. —Editorial note.]

# IN OUR CONTEMPORARIES

## *In New Zealand Journals . . .*

### Cyclic Variability of Rainfall

FLUCTUATIONS AND SECULAR TREND OF NEW ZEALAND RAINFALL: C. J. Seelye, *New Zealand Journal of Science and Technology,* Vol. 31, No. 6, May 1950, pp. 11-24.

RAINFALL AND ITS VARIABILITY OVER THE CENTRAL AND SOUTHWESTERN PACIFIC: C. J. Seelye, *New Zealand Journal of Science and Technology,* Vol. 32, No. 2, September 1950, pp. 11-24.

Outstanding in its contribution to the regional variety of climates in New Zealand is the rapidity of change in annual total and, to some extent, in seasonal concentration of rainfall throughout the country. Such spatial contrasts are well known and are reflected in many features of the landscape. Moreover, such variation is not only spatial in extent but also occurs with time. In earlier papers, Dr. C. J. Seelye has shown the extent and disposition of the annual and monthly variability of rainfall in New Zealand. In his review of the fluctuations and secular trends in rainfall he draws attention to long-term variations in this element of New Zealand weather and climate.

After acknowledging the defects of earlier climatic records, Seelye has established from 108 records over a thirty-year period an annual index of rainfall from which departures from the mean for New Zealand, the North Island and the South Island can be computed. This index is applied to records over a period of eighty-five years in which departures to the order of twenty-five percent are not unknown—the wettest year of 1853 recording a positive departure of twenty-six percent, and the dry year of 1851 a negative departure of thirty-seven percent.

Seelye shows that the smoothed curve of rainfall variability may be correlated closely with the established eleven-year sunspot cycle—a correlation which is closer in the rainfall record of the North Island than it is in that of the South Island. Also appearing in the record is a three-year periodic cycle, the amplitude of which often masks the sunspot variations, and these apparent irregularities will need further investigation before this cyclic development can be made the basis for any long-range weather forecasting.

A consideration of records over the eighty-five years in which they have been kept in New Zealand suggests that there has been an overall decline in annual amounts—of four percent per century in the North Island, and of two percent in the South Island—though whether this is to be persistent or is merely a part of a much larger oscillation cannot, of course, be determined.

The paper suggests possibilities for further research. In particular the discovery of a three-year cycle in rainfall totals, following Kidson's earlier discoveries of a three-year phase in other meteorological phenomena in Australia, suggests that this may be a definite feature in the meteorology of the southwestern Pacific. Its investigation may throw further light on our understanding of the basic circulatory pattern of air in the region.

In the extension of the field of research to the central and southwest Pacific, Seelye in his second paper produces evidence which suggests that tropical climates are not as simple as some textbooks would infer, and that the climatic elements, in particular rainfall, may be more variable in amount and more seasonal in distribution than is sometimes imagined. The annual total, the percentage variability, and the seasonal distribution of rainfall and the seasonal incidence of wet and dry months in the Pacific area between ten degrees north and thirty degrees south and between 150 degrees east and 150 degrees west, are reviewed and mapped. The resulting patterns are related to the zonal circulation, in particular to the south Pacific semipermanent anticyclone and the seasonal migration of the intertropical front.

Contrary to conditions in southeast Asia where the intertropical front migrates through fifty degrees of latitude, the movement of this convergence zone is much restricted east of the 180° meridian. This, combined with upper-air conditions which allow the MT air from the south Pacific semipermanent anticyclone to remain unmodified, produces a relatively dry zone along the equator east of Gilbert Island. The aspects of rainfall reviewed suggest that a close association exists between the climate of the area and the circulation patterns in the south Pacific and that the dominance of the semipermanent anticyclone produces unique rainfall patterns in the area under review.—A. D. Tweedie

## Problems of Climate Classification

THORNTHWAITE'S NEW SYSTEM OF CLIMATE CLASSIFICATION IN ITS APPLICATION TO NEW ZEALAND: B. J. Garnier, *Transactions and Proceedings of the Royal Society of New Zealand,* Vol. 79, Part 1, June 1951, pp. 87-103.

The present paper will be of special interest to those familiar with Mr. Garnier's previous work in applying Thornthwaite's earlier system of classification to New Zealand climates. (See *Annals of the Association of American Geographers,* Vol. 36, September 1946, pp. 151-177.)

Thornthwaite claims that his latest system is more logical in that the climatic subdivisions are determined 'from a study of the climatic data themselves and not from a study of vegetation'. But, as Mr. Garnier points out, to be of much use, the pattern of climates determined by any system of classification must display a general sympathy with phenomena closely related to climate. Since the foundation of this new system is 'potential evapotranspiration', in other words, the water which would be used by vegetation if available, it is inevitable that at some stage an attempt must be made to relate the climatic subdivisions to the observed patterns of vegetation. Much of the present paper is, in fact, taken up with a comparison of the relative merits of Thornthwaite's two systems in differentiating climatic regions in New Zealand.

Some readers will wish that Mr. Garnier's summary of the system of classification had been a little more detailed and critical. The meaning and significance of some of the terms employed are not clear without consulting Thornthwaite's original paper. The novel feature of Thornthwaite's new system is the use of 'potential evapotranspiration' directly as an index of thermal efficiency and, in conjunction with precipitation, as a moisture index. This would appear to present an excellent basis for a satisfactory climatic classification. Unfortunately there is a serious obstacle, since potential evapotranspiration is not one of the elements recorded at climatological stations. It must, therefore, be expressed in terms of standard climatological elements, of which temperature is obviously the most important. By using some measurements of actual water-need at a few places in North America, Thornthwaite develops complicated empirical formulae by means of which water-need can be calculated from monthly mean temperatures, an adjustment being made for total duration of daylight for one month. Even for the selected examples quoted in the original paper, the empirical formulae do not give a good 'fit' to the observations, especially at low temperatures. Thornthwaite himself is not satisfied with it; in his own words: 'The chief obstacle at present to the development of a rational equation is the lack of understanding of why potential evapotranspiration corresponding to a given temperature is not the same everywhere.' Other meteorological factors must exert an influence quite independent of temperature, especially humidity and wind; and the unreliability of a formula dependent only on temperature is scarcely surprising. C. E. P. Brooks (*Meteorological Magazine*, Vol. 77, May 1948) has pointed out that computed values of water-need in southeast England are much too high.

Mr. Garnier produces maps showing the distribution of 'moisture indices', but reaches the conclusion that they are no more effective in bringing out the essential variety of moisture areas in New Zealand than Thornthwaite's original system. If anything, he favours the earlier system. The maps of 'thermal efficiency' provide little contrast throughout New Zealand, except through altitude, the only major division being between the mesothermal climates below about 2500 feet, and the microthermal and colder climates above. For this reason he prefers the thermal classification of the 1931 system.

The new classification also includes two indices determined from the seasonal variation of the main indices. The Canterbury Plains, North and Central Otago, and small areas near Nelson and Blenheim are shown to have a 'summer moisture deficiency'. The index of 'summer concentration of thermal efficiency' shows no variation throughout the country; all areas have 'á' as the fourth letter of this fourfold classification.

The test of any system of classification is whether it works in practice. Mr. Garnier presents this new classification of New Zealand climates as one designed to assist in assessing their agricultural attributes. Workers in agricultural sciences are likely to be the best judges of its merits.—N. G. Robertson

## A Geography of Fiji

THE FIJI ISLANDS: A GEOGRAPHICAL HANDBOOK. By R. A. Derrick. Suva, Fiji: Government Printing Department, 1951, pp. 334.

Those who know Mr. Derrick's *History of Fiji*, and who now read his geography, will agree that he has single-handed provided the student of the Pacific area with a better and more accessible background to the study of this territory than has been hitherto available for any other Pacific island group within the compass of two moderately-sized volumes. Readers will, however, have some reservations about the completeness, balance and usefulness of his geographical handbook and the philosophy behind it. The author modestly claims no more for his work than that it is 'a handbook, and not . . . a textbook of geography', and that its object is 'to supply information'. It contains 'no attempt at embellishment' and, in the phraseology of the foreword of Sir Brian Freeston, the former Governor, it 'owes nothing to Impressionism', but 'depicts . . . masses of accurate detail'.

It is a pity that this volume largely lacks embellishment and a greater pity that, apart from reporting fact, the only trace of impressionism is the author's naive environmentalism. Thus in Fiji climate 'dictates man's diet, clothing and habits, his character and culture, his energy and efficiency'—this despite the complete and early substitution of the Mother Hubbard for traditional clothing and despite the introduction to this new environment of both Indian and European dress. Both Indian and European have brought to this climate their own items of diet. Rice culture and dairy farming are today both significant economic enterprises and their products are important in the diet of all people—not excluding the Fijians.

But on the physical side—in Parts II, III and IV on 'The Physical Structure', 'The Environment' and 'The Islands'—Mr. Derrick provides the regional geographer with an adequate and reliable base for his subsequent and substantive studies. He deals with the geological history of the Fiji group and with the origin of coral reefs. In a workmanlike chapter on climate, he goes back to such fundamentals as the explanation of foehn winds, the difference between weather and climate, the physical properties of land and sea, but does not find it necessary to add a weather map or synoptic chart to the eighteen diagrams, maps, tables and photographs in this short chapter. An all-too-brief chapter, 'Flora and Fauna', lists the more important tree species of the wet zone but fails to mention the vegetation of the *talasiga* grassland and savannah of the dry zone which, as the accompanying maps show, occupy over half the two main islands. Nowhere is there any hint or suggestion that such vegetation might not be 'natural'. However, avoiding theory or controversy, Mr. Derrick reports accurately on the ground he covers, and is most at home discussing the geology and surface configuration of the group and its countless and varied islands.

Nearly half the book consists of a description of hundreds of islands, only ninety-seven of which are inhabited, half of them by less than a hundred people each. Apart from one-sentence terminal notes, these descriptions are usually restricted to physical phenomena such as hills, tides, reefs and anchorages. In all, the human geography of the Fiji group is treated in less than a fifth of the book—in three of nineteen chapters. These are entitled 'Discovery, Charting and Exploration', 'The People', and 'Industries, Trade and Communications'. The last two are short chapters and are tucked away in the section of the volume with the general heading 'The Environment'. Realising that the colour and character of Fiji and its present problems derive so largely from its people and from the human and cultural diversity of the group, many geographers and general readers alike will be disappointed at the overwhelming attention which Mr. Derrick's handbook gives to rocks, coral, mountains and winds. Even on the physical side there are discrepancies; the plant cover is given disproportionately small attention, and the soil is given none at all and does not appear even in the index. In this case Coulter's *Fiji, Little India of the Pacific* (reviewed in *New Zealand Geographer,* Vol. 1, No. 1, April 1945, p. 94) has by no means been replaced. Although the earlier book was based on only a few weeks' fieldwork and may therefore be labelled 'impressionistic', it captures the personality of Fiji better in some ways than Mr. Derrick's report after thirty years' residence.

On the other hand what ground is covered by *The Fiji Islands* is covered well and Mr. Derrick makes a valuable, if incomplete and unbalanced, contribution. The handbook moreover is profusely illustrated. There are maps, cross sections, tables, graphs and diagrams in abundance. Invaluable also are the maps of minute islands in the latter part of the work. Rob Wright's photographs add remarkably to the general appeal of the volume, and serious students will find the index and the lists of islands and islets in the appendices of very great help.

## Adventure and Discovery

CAPTAIN COOK IN NEW ZEALAND. Edited by A. H. and A. W. Reed
Wellington: A. H. and A. W. Reed, 1951, pp. 262.

The idea behind this book is an excellent one, though in some respects it has gone astray. It is an attempt to gather together 'a full account' in Cook's own words 'of his adventures & discoveries in New Zealand'; but what it comes to is a reprint of the published accounts of the voyages, so far as they bear on New Zealand. This is by no means the same thing. For the first voyage Wharton's edition is used. Wharton printed from a copy of the original journal (the present editors seem unaware that this exists in the Commonwealth National Library at Canberra) which at least gives us Cook's words, though frequently respelt and recapitalised by the copyist, and with a vast amount of punctuation poured out by Wharton himself. But the relevant chapters for the second and third voyages have been taken 'after careful consideration' from a nineteenth-century reprint of the eighteenth-century published versions—we are not told what the careful consideration entailed—and it does not seem to be a quite complete text. Nor even do these original versions give us Cook's words, except in a form highly edited and 'improved' for polite consumption. They give us at best the sequence of his thoughts, as prepared for publication. The book therefore does not entirely stand up to its title-page.

The introduction, quoting Wharton too trustingly, repeats some of his stupid mistakes; and the biography of Cook includes a number of misstatements which might have been avoided. For instance, Cook was not the 'obvious' choice to command the *Endeavour,* and he did not choose his own crew; Green was not 'second observer to Cook', he was the officially-appointed astronomer; the observations of the transit of Venus were not 'completely successful'—far from it; Banks never, as far as this reviewer knows, refers to Cook's 'new-fangled' notions about the treatment of scurvy; and it is certainly not true that the *Endeavour* was in no condition for further work after circumnavigating New Zealand.

A number of the editorial footnotes are useful, but there seems little justification for reprinting so many of Wharton's, even with corrections or additions; they could have been entirely rewritten. The reader, also, would welcome in notes some interpretation of such proper names as 'Tomatongeauooranuc' and 'Tringoboohee'. The production of the book reaches a fairly high standard; it is well-printed, and the halftone blocks are most of them good, although the names of the photographers might have been given. The line drawings are amateurish and could well have been dispensed with; and the folding map, presumably a photolithograph, has lost rather too much in sharpness to be satisfactory.

It is necessary to make the foregoing strictures; but it should be added that anyone who wishes to make a first acquaintance with Cook—or, at any rate, Cook as he has so far appeared in print—may fare farther and do worse than make it in the pages of this book. Mr. C. R. H. Taylor's note on the bibliography of Cook is also useful. Nevertheless, he might have given the names of the official publications. If a reviewer may be permitted a personal note, I would ask the editors to refer their footnote 24, p. 46, to p. xvii of my *Discovery of New Zealand,* where I take back the identification of 'Tegadoo' with Tokomaru Bay in favour of Anaura Bay.

—J. C. Beaglehole

## Hunger—A World Problem

GEOGRAPHY OF HUNGER. By Josué de Castro. London: Victor Gollancz Ltd., 1952, pp. 288.

Of all the problems which beset mankind today, none is more frightening than the inadequacy of food resources in the face of increasing world population. Men have identified the problem, measured and described its impact through the centuries, formulated theories as to its causes and future development and almost completely resigned themselves to its habitual existence.

Now from Josué de Castro, Chairman of the Executive of the World Food and Agricultural Organisation, has come one of the outstanding factual studies of the world food problem. The *Geography of Hunger* is not always pleasant reading but it is always stimulating and disturbing. Dr. de Castro has written a book that must be read by everyone who wishes to understand something of the forces which are shaping our future and who hopes to exercise an intelligent influence on future developments in the world, not primarily university professors, but average New Zealand farmers, shopkeepers, office and factory workers, teachers, students and professional men and women. As taxpayers contributing some £3 million towards implementing the Colombo Plan we in New Zealand must have some opinions on the desirability and practicability of measures which we are now helping initiate in Asia. None of us can afford not to face up to the problem of world food shortages.

Dr. de Castro is a nutritionist who develops his thesis according to scientific method and yet who writes with the manner of a skilful novelist. His thesis is that 'hunger and misery are not caused by the presence of too many people in the world, but rather, by having few to produce and many to feed'. He offers positive suggestions for overcoming many of the contributory causes of world hunger, but it is a matter of regret that in an otherwise competent geographic essay the author has not included a single map showing his regions defined by their various degrees of hunger. One of the most interesting theories he advances is that there is a direct *biological* relationship between the standard of living of a people, as reflected in their diet, and their fertility capacity. Where a people appears to be threatened with extinction through a lack of food, both the psychological and physiological mechanisms adapt themselves and the reproductive capacity of the race is increased. If this theory is correct, then the solution to the problem of the high birth rates of the teeming millions of Asia is to raise the dietary standards of the affected peoples to an adequate and sufficient nutritional level. This might be a positive and humane solution to what is undoubtedly the greatest problem of all time.

The food scientists, with their specialised fields of research, can show mankind the way to survival. The thesis developed by de Castro and the solution he offers is full of promise, and is practical, too, but only if individuals are prepared to help develop and support a world plan. This cannot be done without inconvenience, disruption and further modification to the existing political and economic systems of all countries, but these changes are insignificant by comparison with the frightful physiological changes which millions of fellow humans suffer each year through malnutrition and starvation.

The *Geography of Hunger* is an apt title for one of the most interesting and valuable statements yet made on the problem of inadequate food resources and increasing world population.—L. L. POWNALL

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